Si2493/57/34/15/04 Global ISOmodem-EVB

Evaluation Board for the Si2493/57/34/15/04 with a UART Interface

Description

The global Si2493/57/34/15/04-EVB evaluation board provides the system designer an easy way of evaluating the Si2493/57/34/15/04 ISOmodem®. The Si2493/57/34/15/04-EVB consists of a motherboard with a power supply, an RS-232 and USB interface, other ease-of-use features, and a complete removable modem module on a daughter card. (A functional block diagram of the Si2493/57/34/15/04-EVB is shown below.) The Si2493/57/34/15/04 ISOmodem is a complete controller-based modem chipset with an integrated and programmable direct access arrangement (DAA) that meets global telephone line requirements. Available as a combination of one 16-pin small line-side device and one 24-pin or 16-pin system-side device, the Si2493/57/34/15/04 ISOmodem eliminates the need for a separate DSP data pump, modem controller, memories, codec, isolation transformer, relays, opto-isolators, and a 2- to 4-wire hybrid. The Si2493/57/34/15/04 is ideal for embedded modem applications due to its small board area, controller-based architecture, low power consumption, and global compliance. The Si2493/57/34/15/04-EVB provides an RJ-11 jack (for interfacing the Si2493/57/34/15/04-EVB to the phone line), and USB and RS232 serial ports for interfacing to a PC or data terminal. This allows the ISOmodem to operate as a serial modem for straightforward evaluation of the Si2493/57/34/15/04. To evaluate the Si2493/57/34/15/04 ISOmodem in an embedded system, the daughter card can be used independently of or with the motherboard. A direct access header (JP3) is available on the motherboard to bypass the RS-232 transceivers and connect the Si2493/57/34/15/04 ISOmodem directly to a target system.

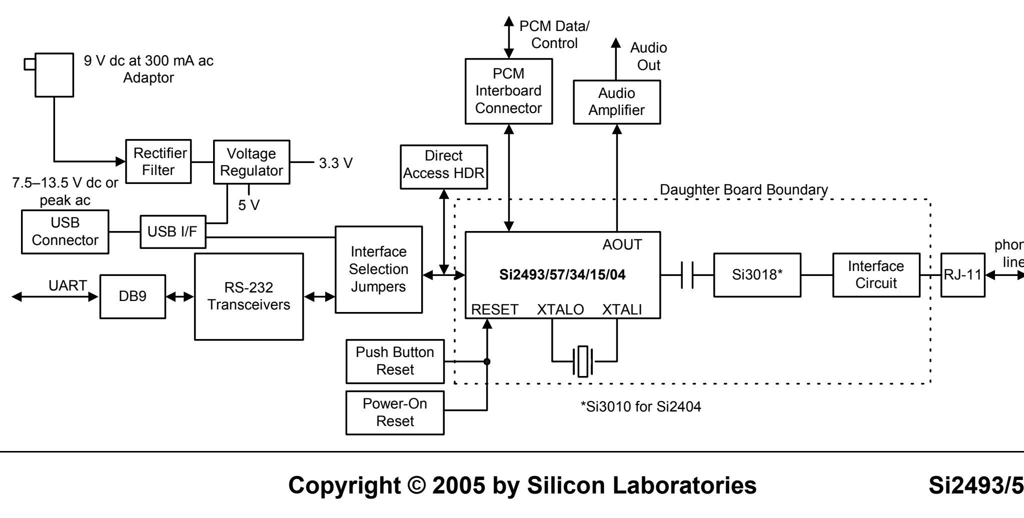
An on-board rectifier, filter, and voltage regulator allow the power input to be 7.5–13 V ac or dc (either polarity) supplied through a screw terminal (J3) or a standard 2 mm power jack (J4). Alternatively, power can be supplied through the USB interface (whether the USB or RS232 interface is used). The evaluation board can drive an external speaker for call monitoring or the piezoelectric speaker mounted directly on the board. Please note that the PCM interface, parallel interface, and EEPROM are available on the FT only. See "1.7.EVB Part Numbers" on page 5 for ISOmodem EVB options.

Features

The Si2493/57/34/15/04-EVB includes the following:

- Dual RJ-11 connection to phone line
- RS-232 and USB interface to PC
- Piezoelectric speaker for call monitoring
- Direct access to Si2493/57/34/15/04 for embedded application evaluation
- Easy power connection to common 7.5 V–13.5 V power supplies or USB port.
- 9 V ac adaptor
- Support for daisy chain operation with Si3000 voice codec (FT only)
- Simple installation and operation
- EEPROM (FT only)

Functional Block Diagram



1. Si2493/57/34/15/04-EVB Setup and Evaluation

This section explains how to set up the Si2493/57/34/15/04-EVB for evaluation as an RS-232 or USB interface modem. Jumper settings, power connection, PC/terminal connections, and terminal program configuration settings are given. The initial modem setup after power is applied as well as a basic tutorial on modem operation are provided. Si2493/57/34/15/04-EVB configurations for evaluating additional features are discussed separately. See the Si2493/57/34/15 or Si2404 data sheets and “AN93: Si2493/57/34/15/04/04 Modem Designer’s Guide” for complete details.

1.1. Si2493/57/34/15/04-EVB Quick Start—RS-232 Interface

1. Set jumpers according to Figure 1 or Figure 2.
2. Connect:
    - DB-9 to PC COM 1 (with a pass-through cable).
    - RJ-11 to phone line or test box.
    - 9 V ac adaptor (or USB cable).
3. Bring up:
    - Turn on power to modem.
    - Autobaud automatically adjusts modem DTE speed and protocol.
4. Type “AT” followed by a carriage return.
    - Should echo “AT” and then an “OK”.

1.2. Si2493/57/34/15/04-EVB Quick Start—USB Interface

1. Set jumpers according to Figure 3 or Figure 4.
2. Connect:
    - USB cable to PC
    - RJ-11 to phone line or test box
3. Download USB driver for your operating system from the CD supplied with the evaluation board.
4. Install driver.
5. Bring up.
    - Reset the modem.
    - Autobaud automatically adjusts modem DTE speed and protocol.
6. Type “AT” followed by a carriage return.
    - Should echo “AT” and then an “OK”.

1.3. Jumper Settings

Check all jumper settings on the Si2493/57/34/15/04-EVB before applying power. The standard factory jumper settings for the FT package are shown in Figure 1; the FS package is shown in Figure 2. These settings configure the Si2493/57/34/15/04-EVB for RS-232 serial operation with autobaud. Any standard terminal program configured to communicate through a PC COM port can be used to communicate with the Si2493/57/34/15/04-EVB. The standard factory jumper settings for USB operation with the FT package are shown in Figure 3; the FS package is shown in Figure 4. The only difference between RS-232 and USB jumper settings is that JP5 must be installed to enable USB.

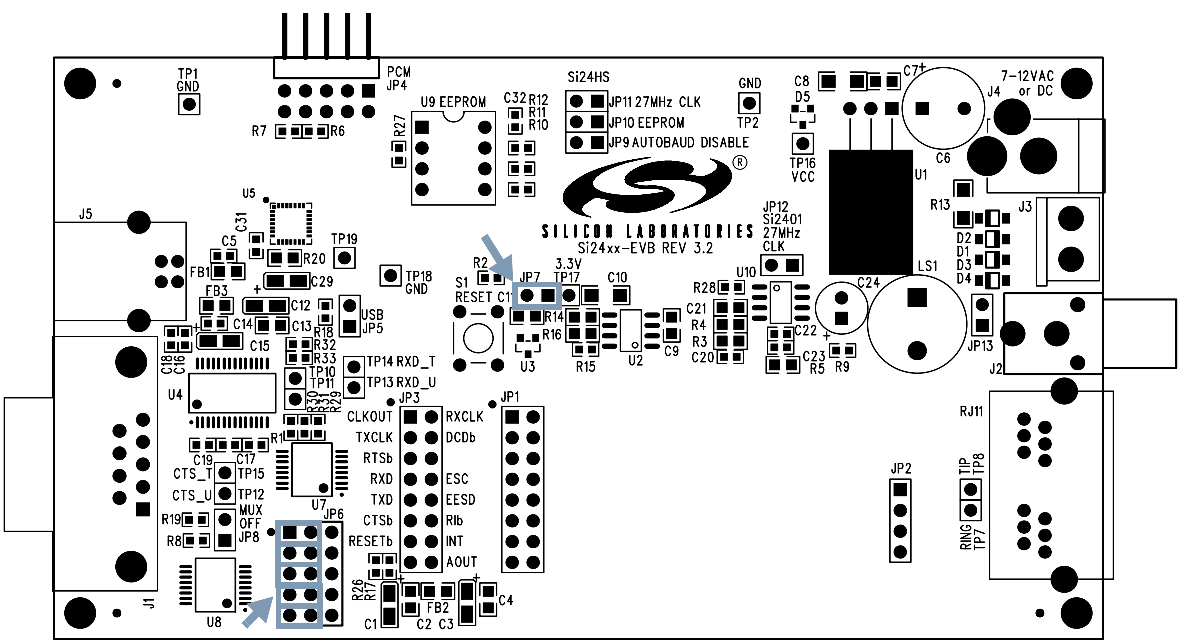


Figure 1. Standard Factory Jumper Settings—RS-232 Interface (Outlined in Gray) (FT Option)

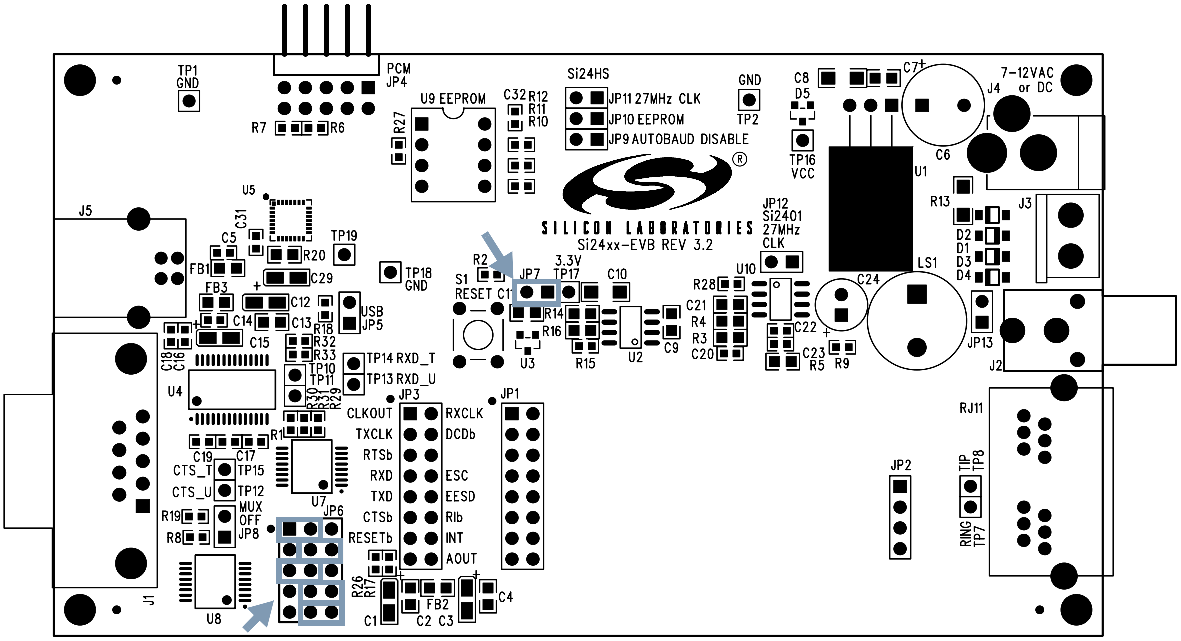


Figure 2. Standard Factory Jumper Settings—RS-232 Interface (Outlined in Gray) (FS Option)

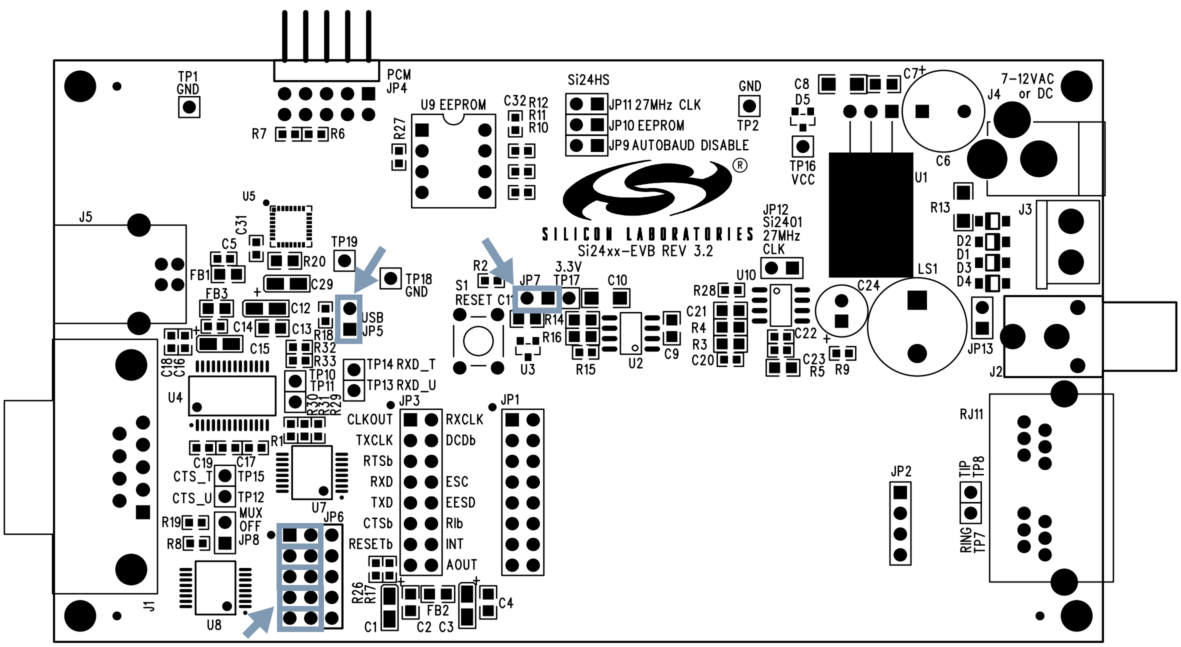


Figure 3. Standard Factory Jumper Settings—USB Interface (Outlined in Gray) (FT Option)

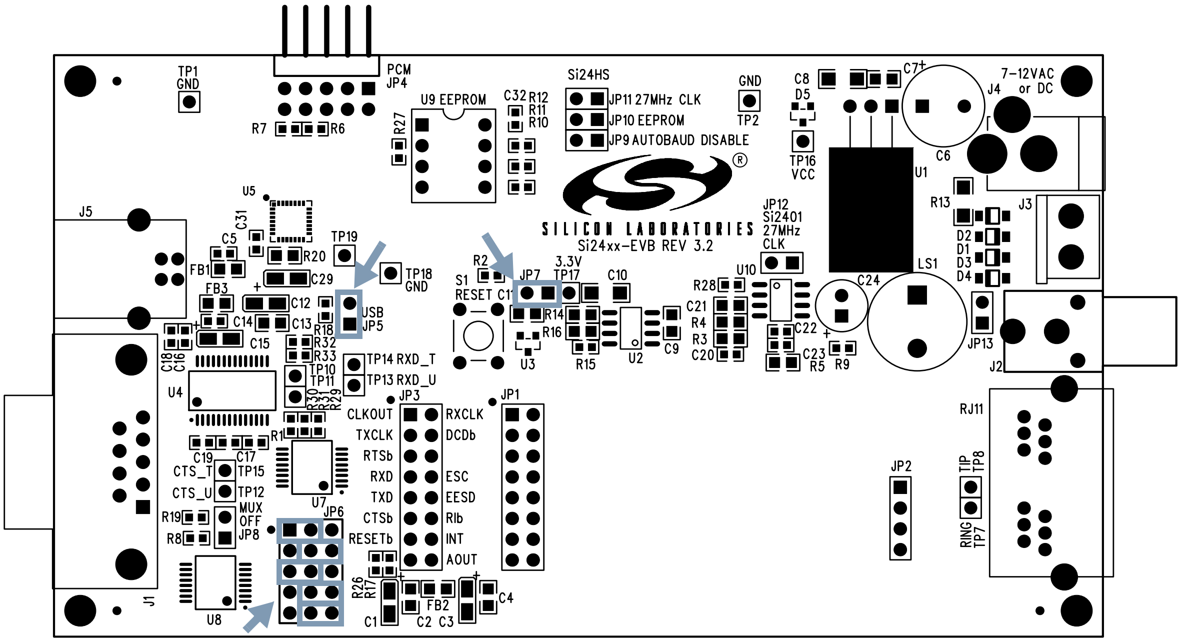


Figure 4. Standard Factory Jumper Settings—USB Interface (Outlined in Gray) (FS Option)

1.4. Power Requirements

The Si2493/57/34/15/04-EVB has an on-board diode bridge, filter capacitor, and voltage regulator (U1). Power can be supplied from any source capable of providing 7.5 V–13 V dc or 7.5 V–13 V peak ac and at least 100 mA. (Additional current may be required if a speaker is connected for monitoring call progress tones.) Power may be applied to the Si2493/57/34/15/04-EVB through the screw terminals (J3), the 2 mm power jack (J4), or the USB cable (even if the modem is configured for RS-232 operation). The onboard full-wave rectifier and filter ensure the correct polarity is applied to the Si2493/57/34/15/04-EVB. Daughter card power is supplied through voltage regulator U2 by connecting JP7, pins 1 and 2. Daughter card current can be measured by connecting an ammeter between JP7, pins 1 and 2. Failure to connect pins 1 and 2 of JP7 through either a jumper or a low-impedance ammeter may result in damage to the Si2493/57/34/15/04-EVB.

1.5. Terminal and Line Connections

The Si2493/57/34/15/04 can be tested as a standard serial data modem by connecting the Si2493/57/34/15/04-EVB to a personal computer or other data terminal equipment (DTE), phone line, and power. Connect a PC serial port to the DB9 connector on the Si2493/57/34/15/04-EVB with a pass-through cable. The RS-232 transceivers on the EVB can communicate with the DTE at rates up to 1 Mbps. Any standard terminal program, such as HyperTerminal or ProComm, running on a PC communicates with the Si2493/57/34/15/04-EVB. The standard factory jumper configuration has autobaud enabled. Autobaud detects the DTE speed, data length, parity, and number of stop bits.

If JP9 is installed, autobaud is disabled. Configure the terminal emulation program to 19200 bps, eight data bits, no parity, one stop bit, and hardware (CTS) handshaking. Connect the RJ-11 jack on the Si2493/57/34/15/04-EVB to an analog phone line or telephone line simulator, such as a Teltone TLS 5.

1.6. Making Connections

With the terminal program properly configured and running, apply power to the Si2493/57/34/15/04-EVB. Type “AT<cr>”, and the modem should return “OK” indicating the modem is working in the command mode and communicating with the terminal. If the “OK” response is not received, try resetting the modem by pressing the manual reset switch (S1); then, again type “AT<cr>.” Next, type “ATI6<cr>.” The modem should respond with “2493”, “2457”, “2434”, “2415”, or “2404” indicating the terminal is communicating with an Si2493, Si2457, Si2434, Si2415, or Si2404.

Type “ATS0=2<cr>” to configure the modem to answer on the second ring.

To take the modem off-hook, type “ATH1<cr>.” The modem should go to the off-hook state, draw loop

current, and respond with an “OK.” Next, type “ATH<cr>” or “ATH0<cr>”, and the modem should hang up (go on-hook) and stop drawing loop current.

To make a modem connection, type “ATDT(called modem phone number)<cr>.” Once the connection is established, a “CONNECT” message appears indicating the two modems are in the data mode and communicating. Typing on one terminal should appear on the other terminal. To return to the command mode without interrupting the connection between the two modems, type “+++.” Approximately two seconds later, “OK” appears. The modem is now in command mode and accepts “AT” commands.Type “ATH” (or “ATH0”) to terminate the data connection, or type “ATO” to return to the data mode. After the ATO command, the modem resumes the data connection and no longer accepts AT commands.

1.7. EVB Part Numbers

The ISOmodem evaluation boards are offered in multiple speeds and packaging options. The first four numbers indicate the system-side device. The next two letters indicate the system-side package (FS–Lead-free, 16-pin SOIC; FT–Lead-free, 24-pin TSSOP). The final two numbers indicate the line-side device. See Figure 5.

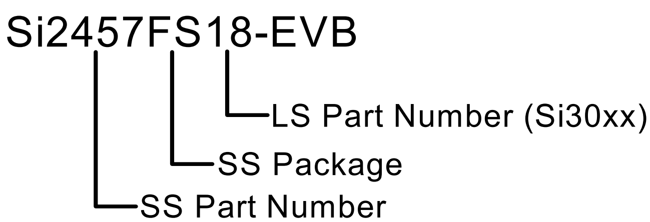


Figure 5. EVB Part Number Example

2. Si2493/57/34/15/04-EVB Functional Description

The Si2493/57/34/15/04-EVB is a multipurpose evaluation system. The modem daughter card illustrates the small size and few components required to implement an entire controller-based modem with global compatibility. The daughter card can be used independently of, or in conjunction with, the motherboard. The motherboard adds features that enhance the ease of evaluating the many capabilities of the Si2493/57/34/15/04 ISOmodem®.

2.1. Motherboard

The motherboard provides a convenient interface to the Si2493/57/34/15/04 DC (daughter card). The versatile power supply allows for a wide range of ac and dc voltages to power the board. RS-232 transceivers and a DB9 connector allow the Si2493/57/34/15/04-EVB to be easily connected to a PC or other terminal device. Jumper options allow direct access to the LVCMOS/TTL level serial inputs to the Si2493/57/34/15/04, bypassing the RS-232 transceivers or USB interface. This is particularly useful for directly connecting the Si2493/57/34/15/04 to embedded systems.

The Si24xxURT-EVB motherboard connects to the daughter card through two connectors, JP1 and JP2. JP1 is an 8x2 socket providing connection to all Si2493/57/34/15/04 digital signals and regulated 3.3 V power for the Si2493/57/34/15/04. The Si2493/57/34/15/04 digital signals appearing at JP1 (daughter card interface) are LVCMOS and TTL compatible. The Si2493/57/34/15/04 daughter card must be powered by 3.3 V. The motherboard is factory configured for 3.3 V with JP7. JP2 is a 4x1 socket providing connection between the daughter card and the RJ-11 phone jack.

2.1.1. Voltage Regulator/Power Supply

The input voltage to either J3 or J4 must be between 7.5 and 13.5 V dc or 7.5 and 13.5 V_{PEAK} ac. The motherboard includes a diode bridge (D1–D4) to guard against a polarity reversal of the dc voltage or to rectify an ac voltage. The power source must be capable of continuously supplying at least 100 mA. C6 serves as a filter cap for an ac input. The voltage regulator, U1, provides 5 V for the motherboard and the input for voltage regulator U2, which outputs 3.3 V for use on the motherboard and to power the daughter card. Si24xxDC power consumption can be measured by placing a meter between pins 1 and 2 of JP7. The connection between JP7 pins 1 and 2 must be made at all times when power is applied to the evaluation board either through a jumper block or a low-impedance meter to avoid damage to the daughter card. Power is supplied to U2 through D5 from the USB.

2.1.2. Reset Circuitry

The Si2493/57/34/15/04 requires a reset pulse to remain low for at least 5.0 ms after the power supply has stabilized during the powerup sequence or for at least 5.0 ms during a power-on reset. Most production Si2493/57/34/15/04 modem chipset applications require that $\overline{\text{RESET}}$ be controlled by the host processor. Certain Si2493/57/34/15/04 operation modes, including powerdown, require a hardware reset to recover.

The Si2493/57/34/15/04-EVB contains two reset options, an automatic power-on reset device, U3 (DS1818) (default), and a manual reset switch (S1) to permit resetting the chip without removing power. A reset, regardless of the mechanism, causes all modem settings to revert to factory default values. See

Figure 13 on page 17 and Figure 15 on page 19 for the reset circuit schematic.

2.1.3. DS1818

The DS1818 is a small, low-cost device that monitors the voltage on V_D and an external reset pushbutton. If V_D drops below 3.0 V, the DS1818 provides a 220 ms active-low reset pulse. On powerup, the DS1818 also outputs an active low reset pulse for 220 ms after V_D reaches 90% of the nominal 3.3 V value. The DS1818 outputs a 220 ms reset pulse any time the power supply voltage exceeds the 3.3 V ±10% window.

2.1.4. Manual Reset

The manual reset switch (S1) performs a power-on reset. This resets the Si2493/57/34/15/04 to factory defaults without turning off power. If S1 is used in conjunction with U3, pressing S1 activates the reset monitor in the DS1818 and produces a 220 ms active low reset pulse.

2.1.5. EEPROM Enable (FT Only)

Connecting JP10 enables the optional EEPROM, U9. See “AN93: Si2457/Si2434/Si2415/Si2404 Modem Designer’s Guide” for programming details.

2.1.6. Interface Selection

The serial interface of the Si2493/57/34/15/04-EVB can be connected to a computer, terminal, embedded system, or any other data terminal equipment (DTE) via a standard RS-232 interface, USB interface, or through a direct TTL serial interface.

The Si2493/57/34/15/04 can be tested as a standard data modem by connecting the Si2493/57/34/15/04-EVB to a personal computer or other DTE power supply and a phone line. A PC can communicate with the Si2493/57/34/15/04-EVB using a standard terminal program, such as HyperTerm or ProComm.

Jumper settings determine how the Si2493/57/34/15/04-EVB is connected to the DTE. Table 1 lists the interface controlled by each motherboard jumper. See Figure 14 on page 18 and Figure 24 on page 28.

Table 1. Interface Selection Jumpers

Jumper	Function
JP1	Daughter Card Digital Connector.
JP2	Daughter Card Phone Line Connector.
JP3	Direct Access Header.
JP4	PCM Interface.
JP5	USB Enable (RS-232 Disable).
JP6	Options.
JP7	3.3 V Power for Daughter Card.
JP8	Disable both RS-232 and USB.
JP9	Autobaud disable.
JP10	EEPROM enable.
JP11	Enable 27 MHz Clock option.
JP12	Not used.
JP13	On-board speaker enable.

2.1.7. RS-232 Interface

This operation mode uses the standard factory jumper settings illustrated in Figure 1 on page 2. The Maxim MAX3237 transceiver interfaces directly with the TTL levels available at the serial interface of the Si2493/57/34/15/04 and, using internal charge pumps, makes these signals compatible with the RS-232 standard. The RS-232 transceiver on the Si2493/57/34/15/04-EVB can communicate at rates between 300 bps and 1 Mbps. This simplifies the connection to PCs and other data terminal equipment (DTE). The signals available on the Si2493/57/34/15/04-EVB serial interface (DB9 connector) are listed in Table 2.

2.1.8. USB Interface

The USB cable connects to J5 on the motherboard and provides both data and power. Installing a jumper on JP5 enables the USB interface and disables the RS-232 interface. The USB interface is provided by U5. A USB driver for this chip is available for most PC and MAC operating systems on the CD.

2.1.9. Direct Access Interface

The motherboard supplies power through J3, J4, or USB, power-on reset, and an RJ-11 jack for the modem. The direct access interface (JP3) is used to connect the motherboard to an embedded system. JP3 provides access to all Si2493/57/34/15/04 signals available on the daughter card. It is necessary to install a jumper on JP8 to disable both the RS-232 and USB interface and prevent signal contention. *Leave the jumper between JP7 pins 1 and 2.* Figures 6 and 7 illustrate the jumper settings required for the direct access mode using the motherboard.

2.1.10. PCM Interface (FT Only)

The Si2493/57/34/15/04 PCM interface is available on JP4. Table 3 lists the pin connections for JP4 designed to connect directly to the Si3000SSI-EVB JP6.

Table 2. DB9 Pin Connections

J1 Name	J1 Symbol	J1 Pin	Si2493/57/34/15/04 Pin	Si2493/57/34/15/04 Name
Carrier Detect	CD	1*	See note	$\overline{\text{DCD}}$/EESD
Received Data	RXD	2	9	RXD
Transmit Data	TXD	3	10	TXD
Data Terminal Ready	DTR	4*	See note	ESC/RI
Signal Ground	SG	5	6	GND
Data Set Ready	DSR	6*	See note	$\overline{\text{INT}}$/AOUT
Ready to Send	RTS	7*	See note	$\overline{\text{RTS}}$/RXCLK
Clear to Send	CTS	8	11	$\overline{\text{CTS}}$
Ring Indicator	RD	9*	17	$\overline{\text{RI}}$
***Note:** JP6 jumper option.				

Table 3. JP 4 PCM Interface Pin Connections

JP 4 Pin	Board Signal	Si24xx Pin	Si24xx Signal
1	CLKOUT_H	3	CLKOUT
2	TXCLK_H	4	FSYNC
3	GND	6, 20	GND
4	GND	6, 20	GND
5	RXCLK_H	24	SDO
6	EESD_H	18	SDI
7	RESETb	12	RESET*
8	3.3 V	5, 21	VD3.3
9	GND	6, 20	GND
10	VCC (+5 V)		

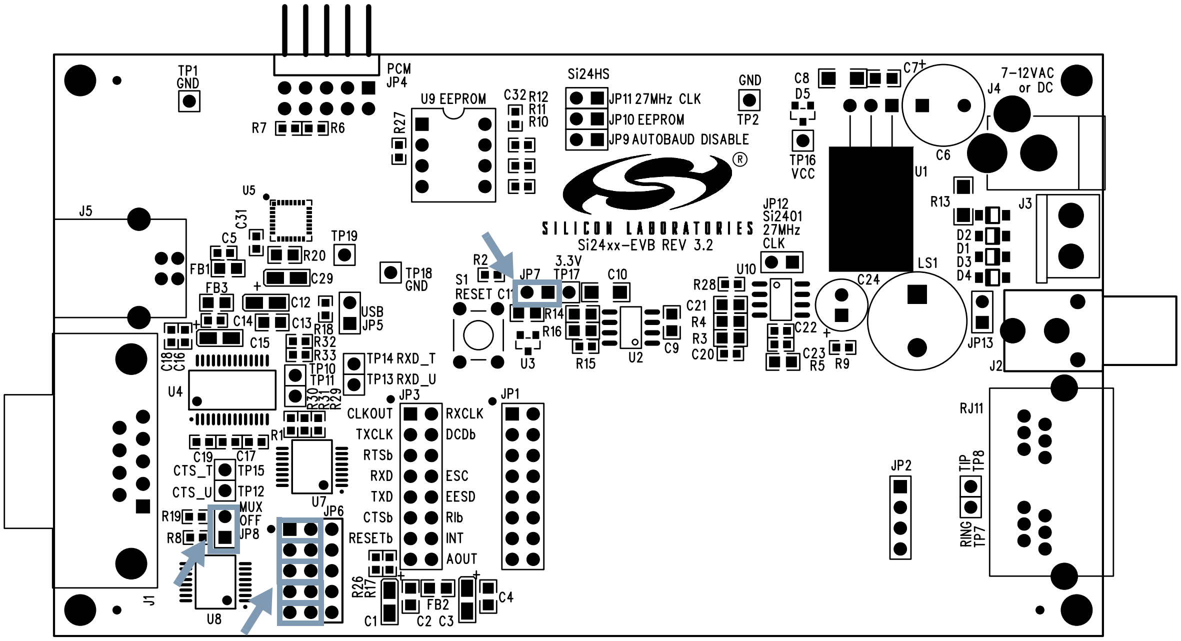


Figure 6. Jumper Settings for Direct Access Interface (FT Option)

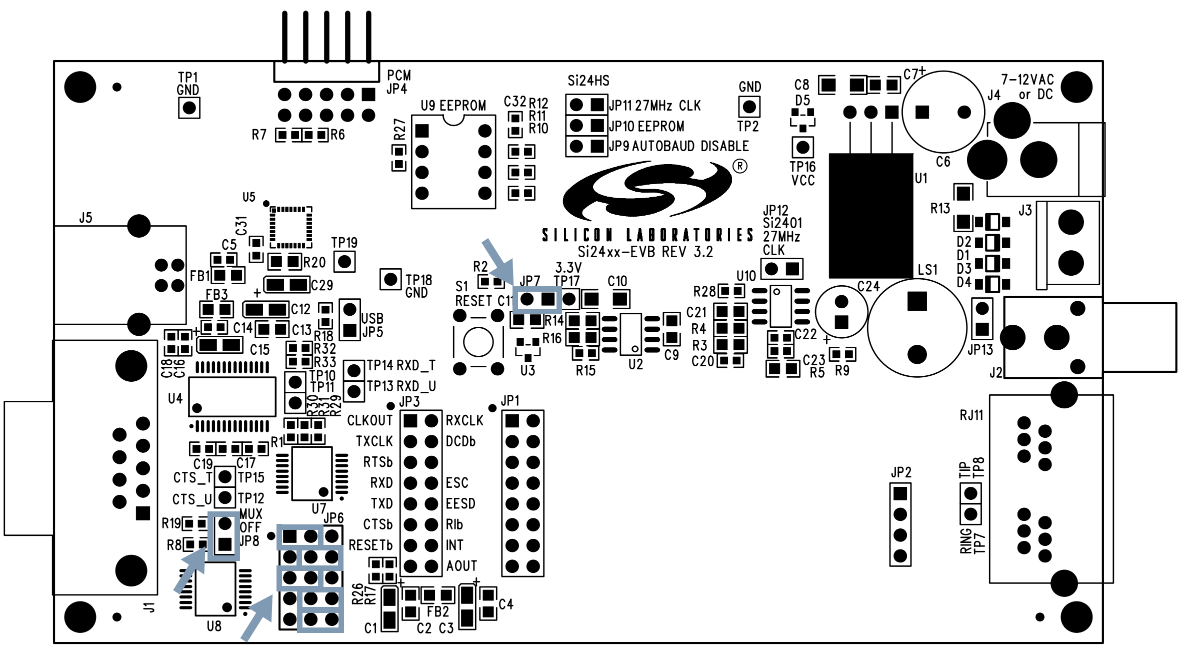


Figure 7. Jumper Settings for Direct Access Interface (FS Option)

The block diagram in Figure 8 shows how the two evaluation boards are connected to demonstrate voice mode operation.

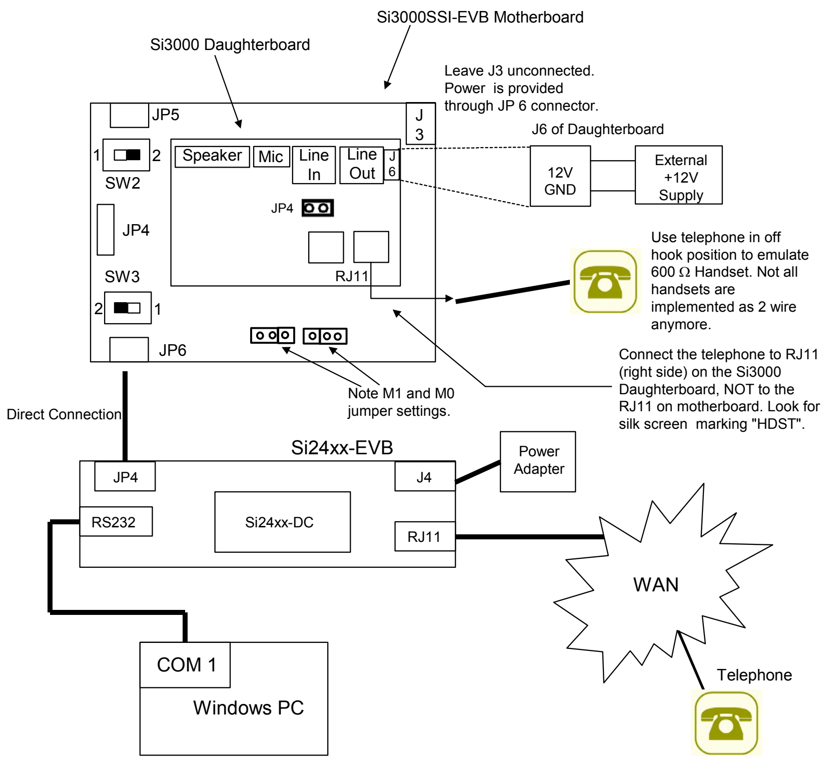


Figure 8. Connection Block Diagram for Si3000SSI-EVB and Si24XXURT-EVB

2.1.11. Voice Mode

The Si3000 is used in conjunction with the Si2493/57/34/15/04 to transmit and receive 16-bit voice samples to and from telephone lines as shown in Figure 9.

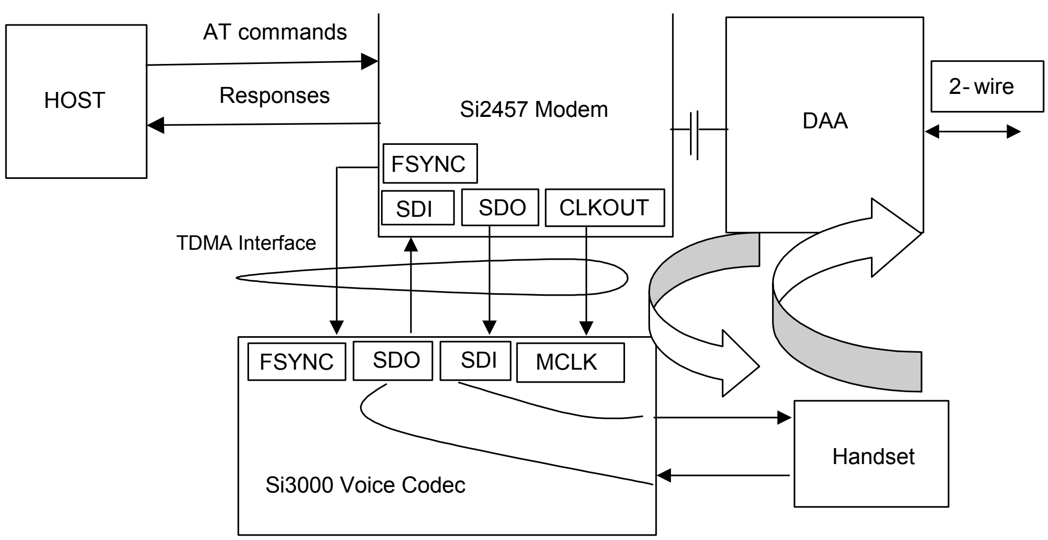


Figure 9. Voice Mode Block Diagram

Figure 10 shows the actual circuit connection between the Si2493/57/34/15/04 and the Si3000.

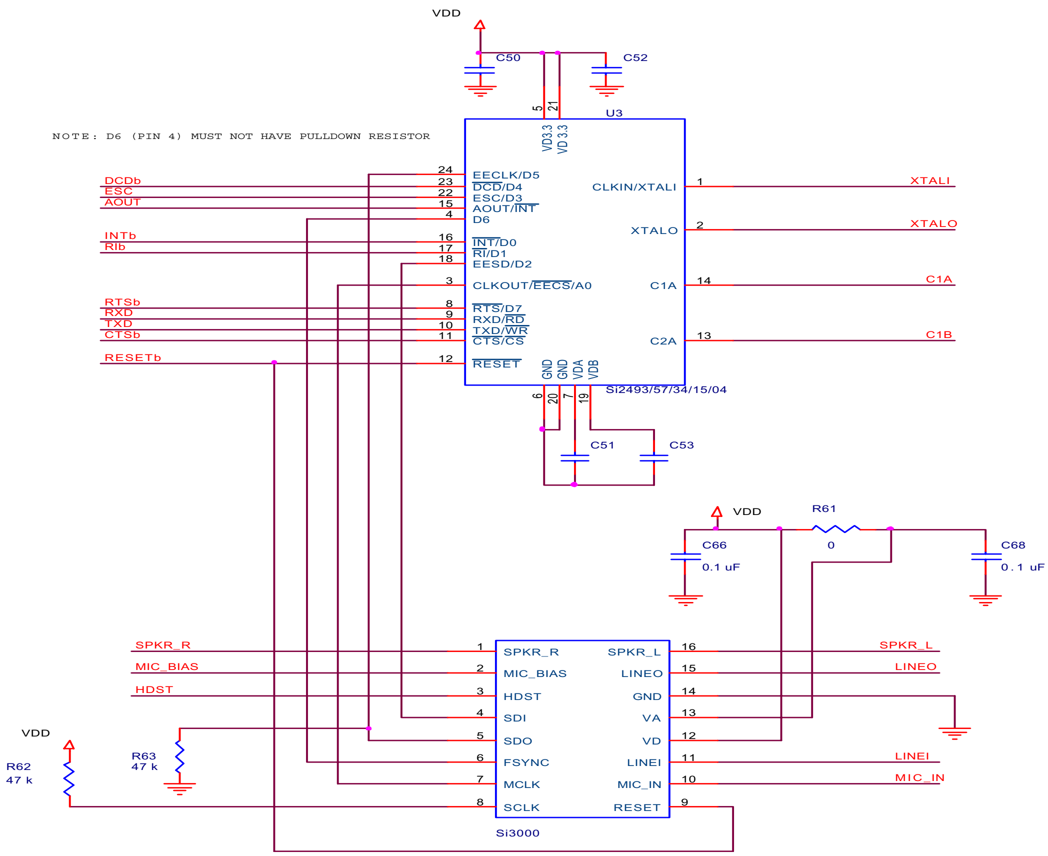


Figure 10. Circuit Connection between the Si2493/57/34/15/04 and the Si3000

To use voice mode register U71 and data memory location 0x0059 must be properly configured.

Setting data memory 0x0059 = 0x0001 enables the Si24XX TDMA interface. When U71 is set to the value 0x0011 a 16-bit voice sample will be transmitted from the Si3000 through the Si2493/57/34/15/04 and DAA to the remote device. Likewise, an analog signal from the remote device will pass through the DAA where it is converted to a 16-bit voice sample, the Si24XX and finally the Si3000 where it is converted back to the analog receive signal.

In this example, the Si3000 has its digital TDMA interface configured as the Slave Serial Mode by adding a 50 kΩ pull-down resistor to SDO pin and a pull-up 50 kΩ resistor to SCLK pin. In this mode, the Si3000's MCLK is driven by the 2048 kHz clock from Si2493/57/34/15/04. The FSYNC has an 8 kHz pulse input. The bit clock is 2048/8 = 256 bits per frame sync. Refer to the Si3000 documentation for further details.

To send control information to the Si3000, the Si2493/57/34/15/04 modem chip provides a PCM control port 0x004B that allows the user to send control words across by using the AT memory write command. See Table 4. for details. Wait for the "OK" (approximately 300 ms after each command). When a connection is established, the "AT." command is used to generate the DTMF tone of a number; For example, AT.3<CR> will generate a number 3 DTMF tone without the need for an external DTMF generator. See "Voice Mode Example" for details.

Table 4. Voice Commands

AT Commands	Purposes
AT:U71,11	Configure modem to send/receive data in linear mode to/from Si3000 interface
AT*Y254:W0059,7785	Enable Si2457 modem TDMA's interface by setting LSBit of memory 0x0059
AT*Y254:W004B,011C	Write to Si3000 Control Reg1: Line Driver, Handset Driver, and Microphone Bias Normal Operations are enabled.
AT*Y254:W004B,0200	Write to Si3000 Control Reg2: HPF enabled, PLL divided by 5, Digital Loopback Off
AT*Y254:W004B,0300	Write to Si3000 Control Reg3: PLL Divider N1
AT*Y254:W004B,0400	Write to Si3000 Control Reg4: PLL Divider M1
AT*Y254:W004B,055A	Write to Si3000 Control Reg5: Line-In, Mic-In, Handset-In, FIR are activated.
AT*Y254:W004B,067F	Write to Si3000 Control Reg6: Line-Out, Handset-Out are activated.
AT*Y254:W004B,075F	Write to Si3000 Control Reg7: SPKR_L, SPLR_R are activated.
ATH1	Off-hook command for calling
AT.1	Dial individual number 1
AT.0	Dial individual number 0
AT.4	Dial individual number 4 and wait for answer

2.2. Voice Mode Example

Perform the following steps:

1. Connect hardware as shown in Figure 8 on page 9. Note that the Si3000 Evaluation Board requires an external 12 V supply and derives 5 V power from the Si24xx-EVB. The Si24xx-EVB should be connected to the supplied power adapter or powered through USB.
2. Enter the following AT commands to initialize the modem:

```
ATZ                              reset modem
ATE0                             disable echo
AT:U0071,11                      enable voice routing firmware
AT*Y254:W0059,7785               enable Si3000 Hardware Interface
                                 In actual application, this line
                                 must be implemented as a read-modify-
                                 write consisting of the following:
                                 n = AT*Y254:Q0059
                                 n |= 1
                                 AT*Y254:W0059,n
AT*Y254:W004B,011C               Si3000 Reg 01 = 1C
                                 This applies power to SPKRx,HDST,LINEO
AT*Y254:W004B,0545               Si3000 Reg 05 = 45
                                 Enable HDST into ADC mixer
                                 MIC input disabled
                                 LINEI input disabled
AT*Y254:W004B,065D               Si3000 Reg 06 = 6D
                                 Activate HDST as output
                                 Keep LINEO muted
0 db Receive Gain Setting
AT*Y254:W004B,075C               Si3000 Reg 07 = 5C
                                 0 dB Transmit Gain
                                 Keep SPKRx muted
```

3. Type "ATDTnnn", where nnn represents the telephone number of the remote telephone.
4. The remote phone rings and should be picked up.
5. Also pick up the local phone connected to the Si3000 Evaluation Board.
6. At this point, a voice connection exists between the two telephones.
7. It is also possible to send a series of single digit DTMF tones to the remote phone using the "AT.N" command (dot character is in-between "AT" and "N", where N is a DTMF digit 0-9,A-F).
   Example:
   AT.1 sends DTMF digit 1, return to voice mode.

2.2.1. Audio Output

Audio output is provided from the Si2457/34/15 on the AOUT pin. This signal allows the user to monitor call progress signals, such as dial tone, DTMF dialing, ring, busy signals, and modem negotiation. Control of this signal is provided by AT commands and register settings described in the introduction. The AOUT signal can be connected to an amplifier, such as the LM386 (the default stuffing option on the Si2457/34/15URT-EVB), for high-quality output. AOUT can also be connected to a summing amplifier or multiplexer in an embedded application as part of an integrated audio system.

2.2.2. Amplifier (LM386)

The audio amplifier circuit consists of U10 (LM386), C20, R3, R4, C21, C22, C23, R5, C24, and an optional loudspeaker, LS1. The LM386 has an internally-set voltage gain of 20. R3 and R4 provide a voltage divider to reduce the AOUT signal to prevent overdriving the LM386. C20 provides dc blocking for the input signal and forms a high-pass filter with R3+R4 while R4 and C21 form a low-pass filter. These four components limit the bandwidth of the AOUT signal. C22 provides high-frequency power supply bypassing for the LM386 and should be connected to a hard ground and located very close to the amplifier's power supply and ground pins. C23 and R5 form a compensation circuit to prevent oscillation of the high current PNP transistor in the LM386 output stage on negative signal peaks. These oscillations can occur between 2–5 MHz and can pose a radiation compliance problem if C23 and R5 are omitted. C24 provides dc blocking for the output of the LM386, which is biased at approximately 2.5 V ($V_{CC}/2$), and forms a high-pass filter with the impedance of the loudspeaker (LS1). The output from the LM386 amplifier circuit is available on the RCA jack, J2 (not installed). Install jumper JP13 to enable the on-board speaker, LS1.

2.3. Modem Module Operation

The Si2457/34/15URT-EVB daughter card is a complete modem solution perfectly suited for use in an embedded system.

The daughter card requires a 3.3 V supply capable of providing at least 35 mA and communicates with the system via LVCMOS/TTL-compatible digital signals on JP1. The RJ-11 jack (TIP and RING) is connected via JP2. Be sure to provide the proper power-on reset pulse to the daughter card if it is used in the stand-alone mode.

2.3.1. Reset Requirements

The Si2457/34/15 ISOmodem® daughter card must be properly reset at powerup. The reset pin (pin 8) of the Si2457/34/15 (JP1, pin 13) must be held low for at least 5.0 ms after power is applied and stabilized to ensure the device is properly reset.

2.3.2. Crystal Requirements

Clock accuracy and stability are important in modem applications. To ensure reliable communication between modems, the clock must remain within ±100 ppm of the design value over the life of the modem. The crystal selected for use in a modem application must have a frequency tolerance of less than ±100 ppm for the combination of initial frequency tolerance, drift over the normal operating temperature range, and five year aging. Other considerations, such as production variations in PC board capacitance and the tolerance of loading capacitors, must also be taken into account.

2.3.3. Protection

The Si2493/57/34/15/04-EVB meets or exceeds all FCC and international PTT requirements and recommendations for high-voltage surge and isolation testing without any modification. The protection/isolation circuitry includes C1, C2, C8, C9, FB1, FB2, and RV1. The PCB layout is also a key "component" in the protection circuitry. The Si2493/57/34/15/04-EVB provides isolation to 3 kV. Contact Silicon Laboratories for information about designing to higher levels of isolation.

3. Design

The following sections contain the schematics, bill of materials, and layout for the Si2493/57/34/15/04 including the daughter card and motherboard.

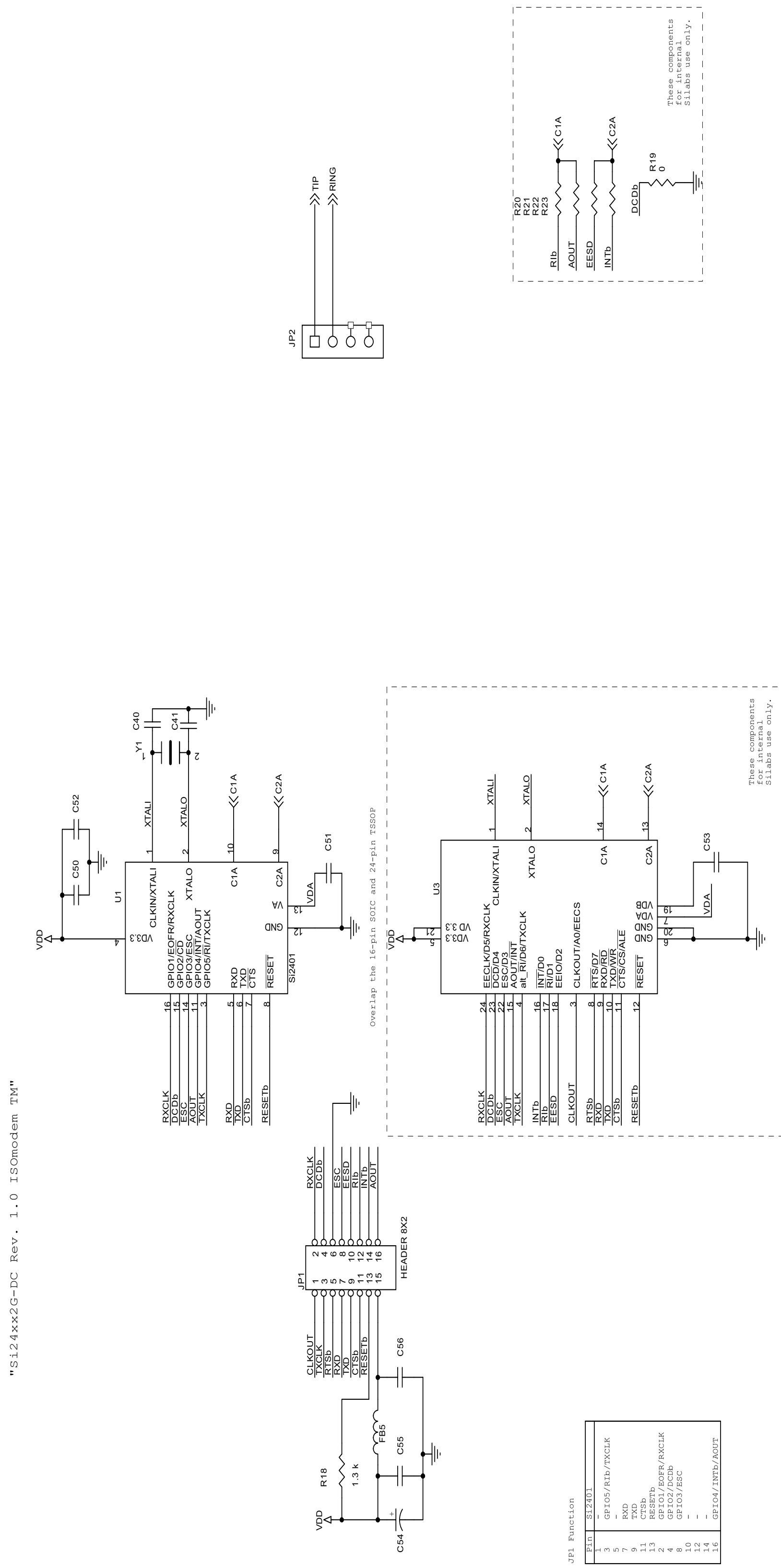


Figure 11. Si2493/57/34/15/04 Schematic

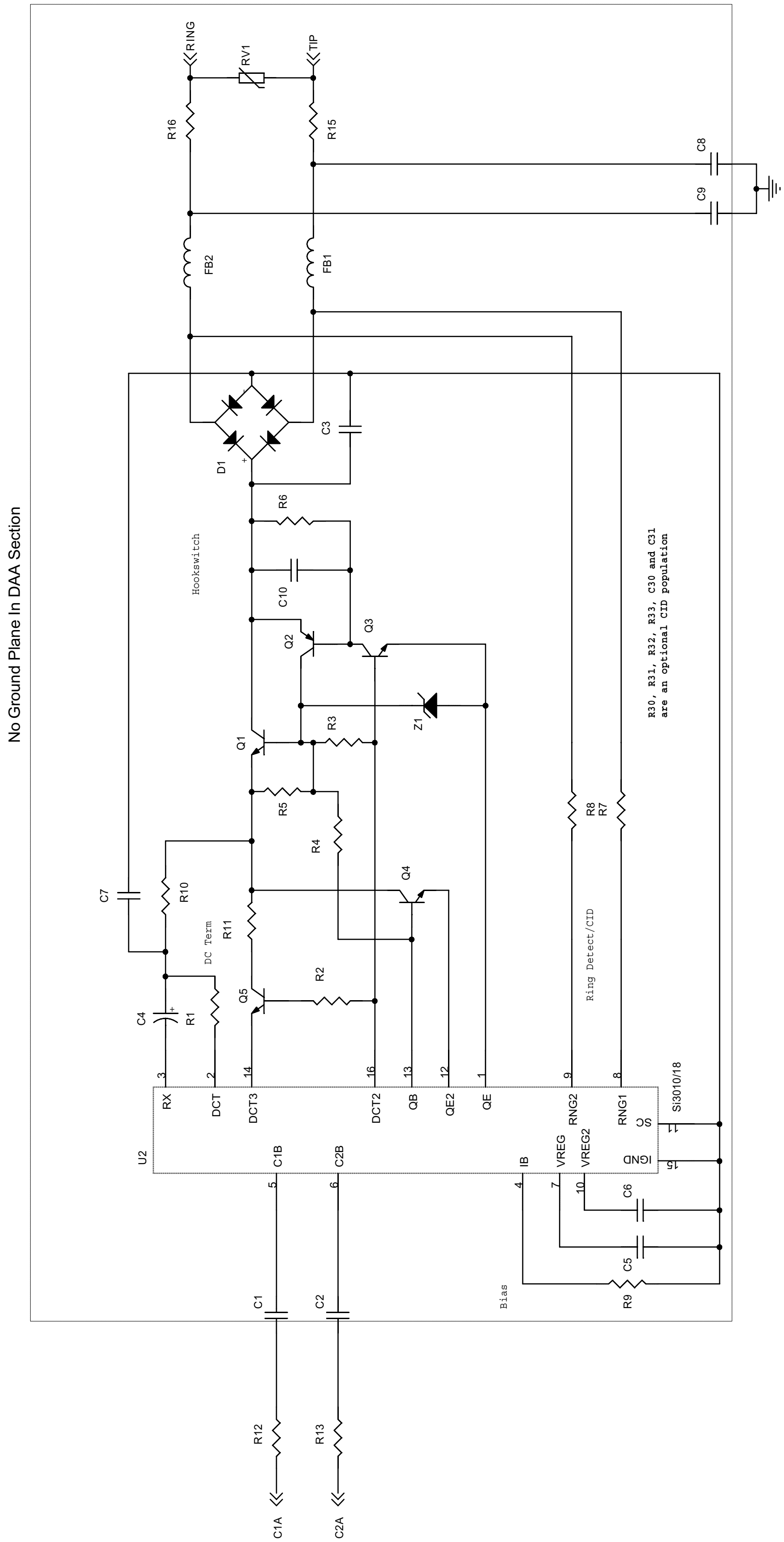


Figure 12. Si3018/10 DAA Schematic

4. Bill of Materials: Si24xx Daughter Card

Item	Quantity	Reference	Value	Rating	Tolerance	Foot Print	Dielectric	Manufacturer Number	Manufacturer
1	2	C2,C1	33 pF	Y2	±20%	1808	X7R	GA342D1XGF330JY02L	Murata
2	1	C3	10 nF	250 V	±20%	0805	X7R	C0805X7R251-103MNE	Venkel
3	1	C4	1.0 uF	50 V	±20%	Size A	Al Electrolytic	NACE1R0M50V	NIC Components
4	3	C5,C6,C50	0.1 uF	16 V	±20%	0603	X7R	C0603X7R160-104MNE	Venkel
5	1	C7	2.7 nF	50 V	±20%	0603	X7R	C0603X7R500-272MNE	Venkel
6	2	C9,C8	680 pF	Y3	±10%	1808	X7R	GA342QR7GD681KW01L	Murata
7	1	C10	0.01 uF	16 V	±20%	0603	X7R	C0603X7R160-103MNE	Venkel
8	2	C41,C40	33 pF	16 V	±5%	0603	NPO	C0603NPO160-330JNE	Venkel
9	1	C51	0.22 uF	16 V	±20%	0603	X7R	C0603X7R160-104MNE	Venkel
10	1	C54	1.0 uF	10 V	±10%	Case A	Tant	TA010TCM105-KAL	Venkel
11	1	D1	HD04	400 V		Mini-DIP		HD04-T	Diodes, Inc.
12	2	FB1,FB2,FB5	Ferrite Bead			0603		BLM18AG601S	MuRata
13	1	JP1	HEADER 8X2			2x8 Surface Mount Header, .1 space		TSM-108-01-T-DV	Samtec
14	1	JP2	4X1 Header_0			CONN1X4-100-SMT		68000-403	Berg
15	2	Q3,Q1	NPN	300 V		SOT-23		MMBTA42LT1	OnSemi
16	1	Q2	PNP	300 V		SOT-23		MMBTA92LT1	OnSemi
17	2	Q4,Q5	NPN	80 V		SOT-23		MMBTA06LT1	OnSemi
18	1	RV1	SiDactor	275 V	100 A	SOD 6		P3100SB	Teccor
19	1	R1	1.07 K	1/2 W	±1%	1210		CR1210-2W-1071FT	Venkel
20	1	R2	150	1/16 W	±5%	0402		CR0402-16W-150JT	Venkel
21	1	R3	3.65 K	1/2 W	±1%	1210		CR1210-2W-3651FT	Venkel
22	1	R4	2.49 K	1/2 W	±1%	1210		CR1210-2W-2491FT	Venkel
23	2	R5,R6	100 K	1/16 W	±5%	0402		CR0402-16W-104JT	Venkel
24	2	R8,R7	20 M	1/8 W	±5%	0805		CR0805-8W-206JT	Venkel
25	1	R9	1 M	1/16 W	±1%	0402		CR0402-16W-1004FT	Venkel
26	1	R10	536	1/4 W	±1%	1206		CR1206-4W-5360FT	Venkel
27	1	R11	73.2	1/2 W	±1%	1210		CR1210-2W-73R2FT	Venkel
28	4	R12,R13,R15,R16	0	1/16 W	±1%	0603		CR0603-16W-000F	Venkel
29	1	U3	Si24xx			24pin TSSOP			Silicon Laboratories
30	1	U2	Si3018/10			16pin SOIC		Si3018/10-FS	Silicon Laboratories
31	1	Y1	4.9152Mhz	20pF load, 150 ESR	50 ppm	ATS-SM		559-FOXSD049-20	CTS Reeves
32	1	Z1	43 V	1/2 W		SOD-123		MMSZ43T1	OnSemi

Non-installed Components

Item	Quantity	Reference	Value	Rating	Tolerance	Foot Print	Dielectric	Manufacturer Number	Manufacturer
33	2	C31,C30	120pF	250 V	±10%	0805	X7R	C0805X7R251-121KNE	Venkel
34	2	C55,C56	0.1 uF	10 V	±20%	C0603	X7R	C0603C124K	Kemet
35	1	R18	1.3 k	1/16 W	±5%	RC0603		CR0603-16W-132JT	Venkel
36	5	R19,R20,R21,R22,R23	0	1/16W	±5%	RC0603		CR0603-16W-000J	Venkel
37	2	R32,R30	15M	1/8 W	±5%	0805		CR0805-8W-156JT	Venkel
38	2	R33,R31	5.1M	1/8 W	±5%	0805		CR0805-8W-515JT	Venkel
39	1	C52	0.1 uF	16 V	±20%	0603	X7R	C0603X7R160-104MNE	Venkel
40	1	C53	0.22 uF	16 V	±20%	0603	X7R	C0603X7R160-104MNE	Venkel
41	1	U1	Si2401			16pin SOIC		Si2401-KS	Silicon Laboratories

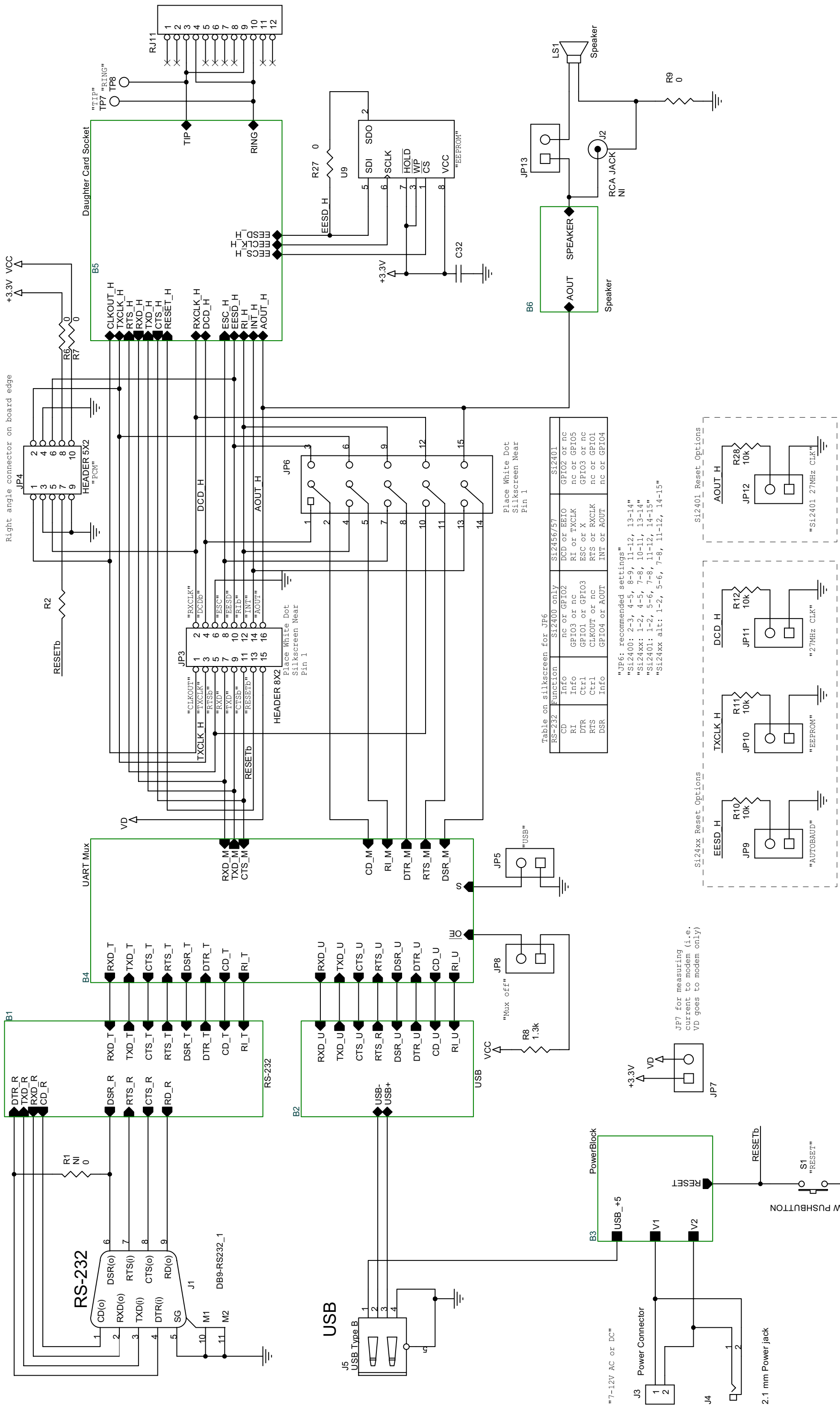
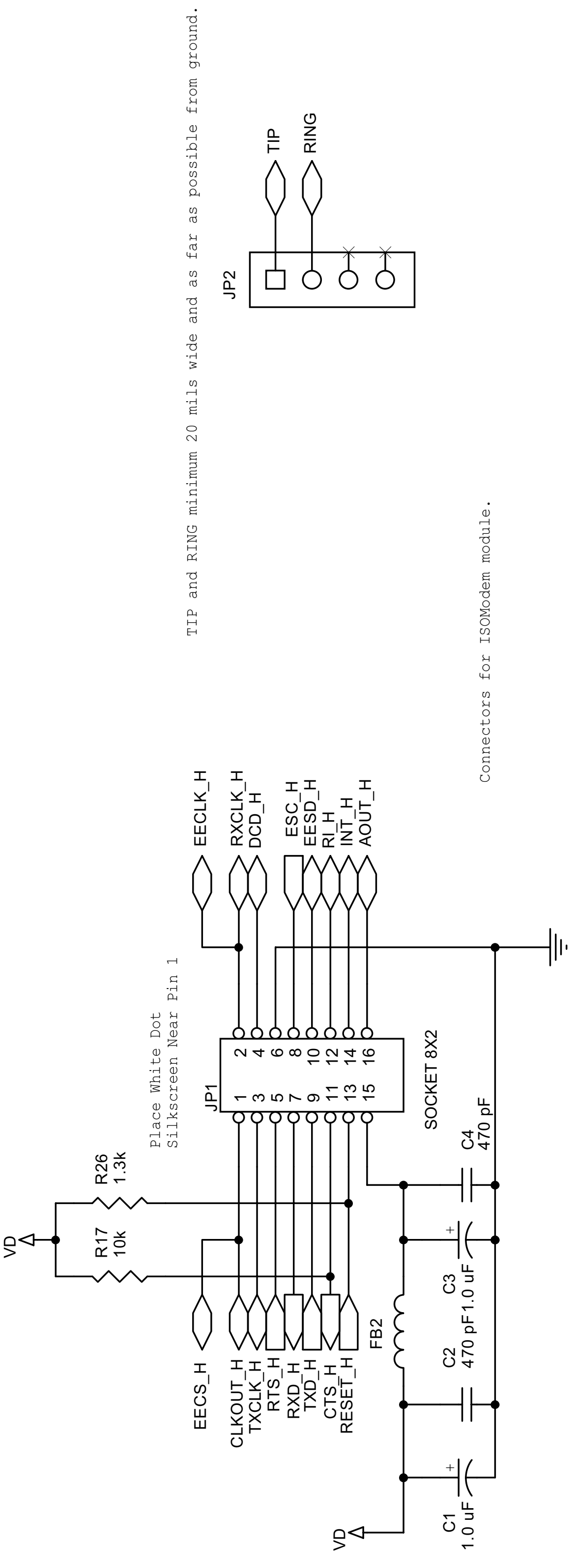


Figure 13. Motherboard Top-level Schematic



Net names correspond to
Si24xx. See table for
Si2400 equivalents

Table NOT on silkscreen

JP1/3	Si2400	Si24xx	Si2401
1	NC	CLKOUT/A0/EECS	NC
2	NC	EECLK/D5/RXCLK	GPIO1
3	NC	alt_RIb/TXCLK/D6	GPIO5
4	NC	DCD/D4	GPIO2
5	CLKOUT	RTS/D7	NC
6	GND	GND	GND
7	TXD	TXD/WR	TXD
8	GPIO1	ESC/D3	GPIO3
9	RXD	RXD/RD	RXD
10	GPIO2	EESD/D2	NC
11	CTS	CTS/CS	CTS
12	GPIO3	RI/D1	NC
13	RESET	RESET	RESET
14	GPIO4	INT/D0	NC
15	VD	VD	VD
16	AOUT	AOUT/INT	GPIO4

Figure 14. Daughter Card Interface Schematic

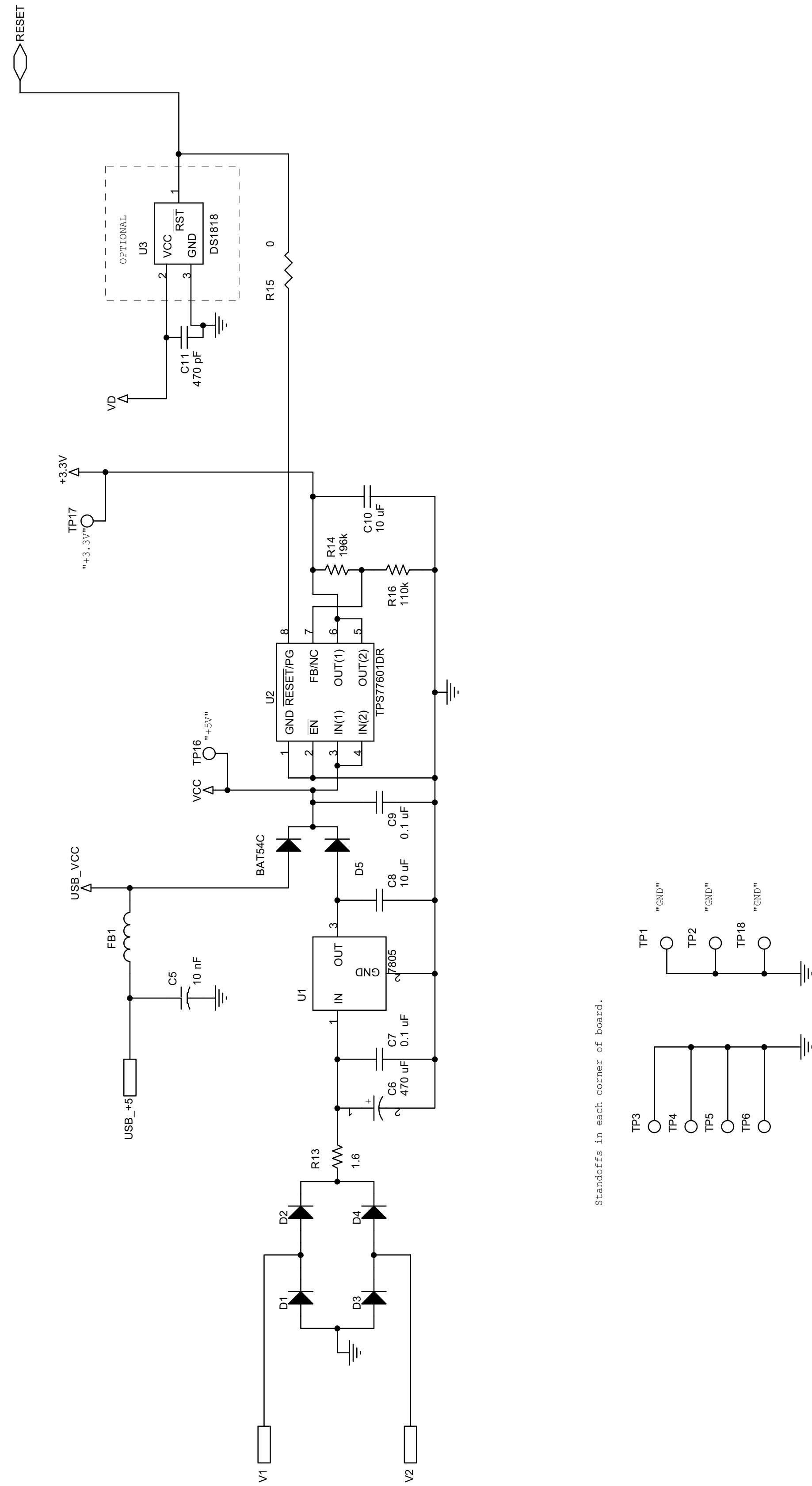


Figure 15. Power Supply Schematic

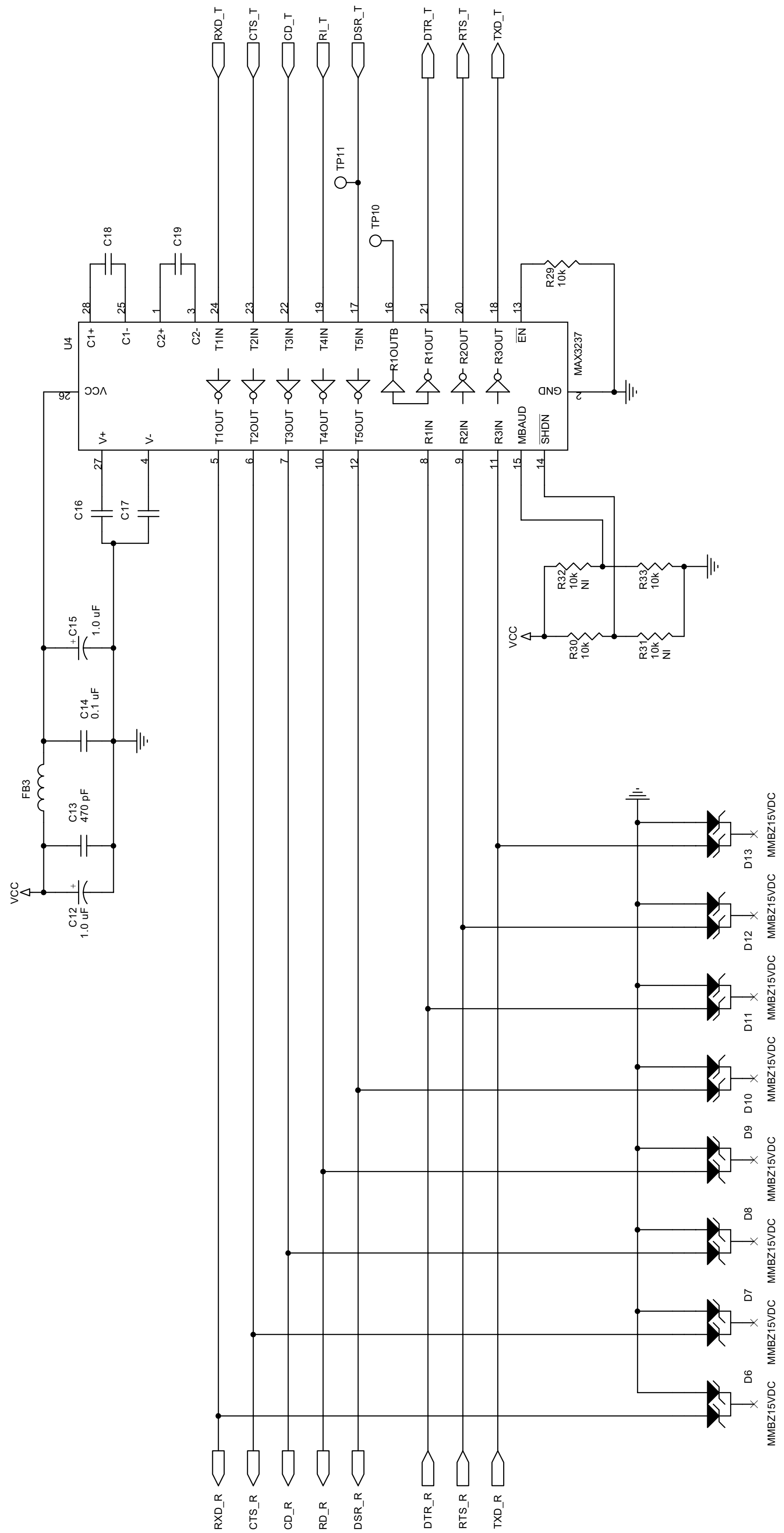


Figure 16. RS-232 Interface Schematic

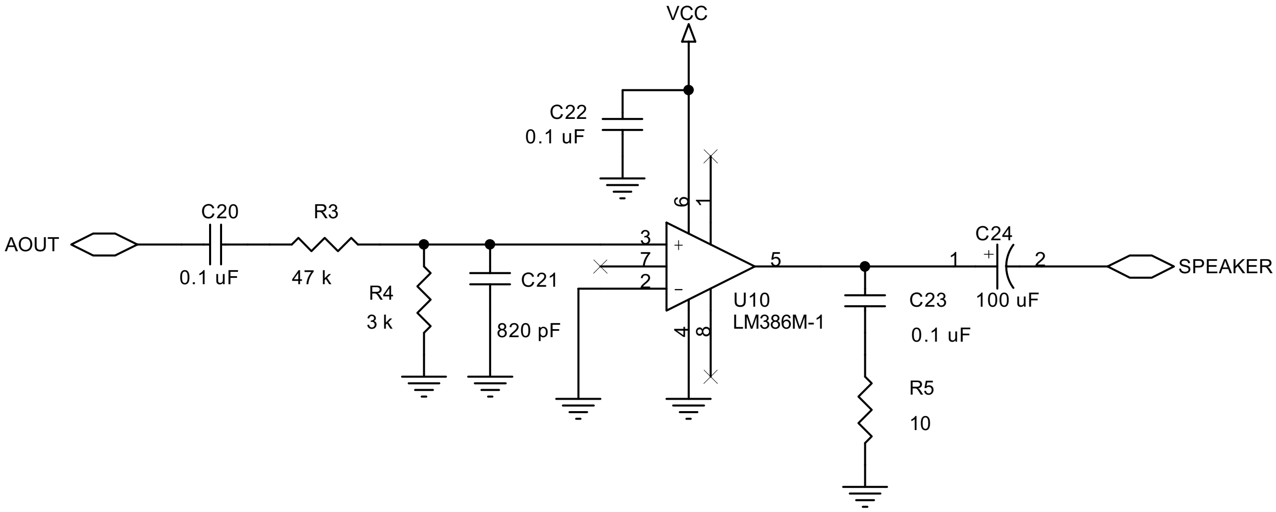


Figure 17. Audio Amplifier Schematic

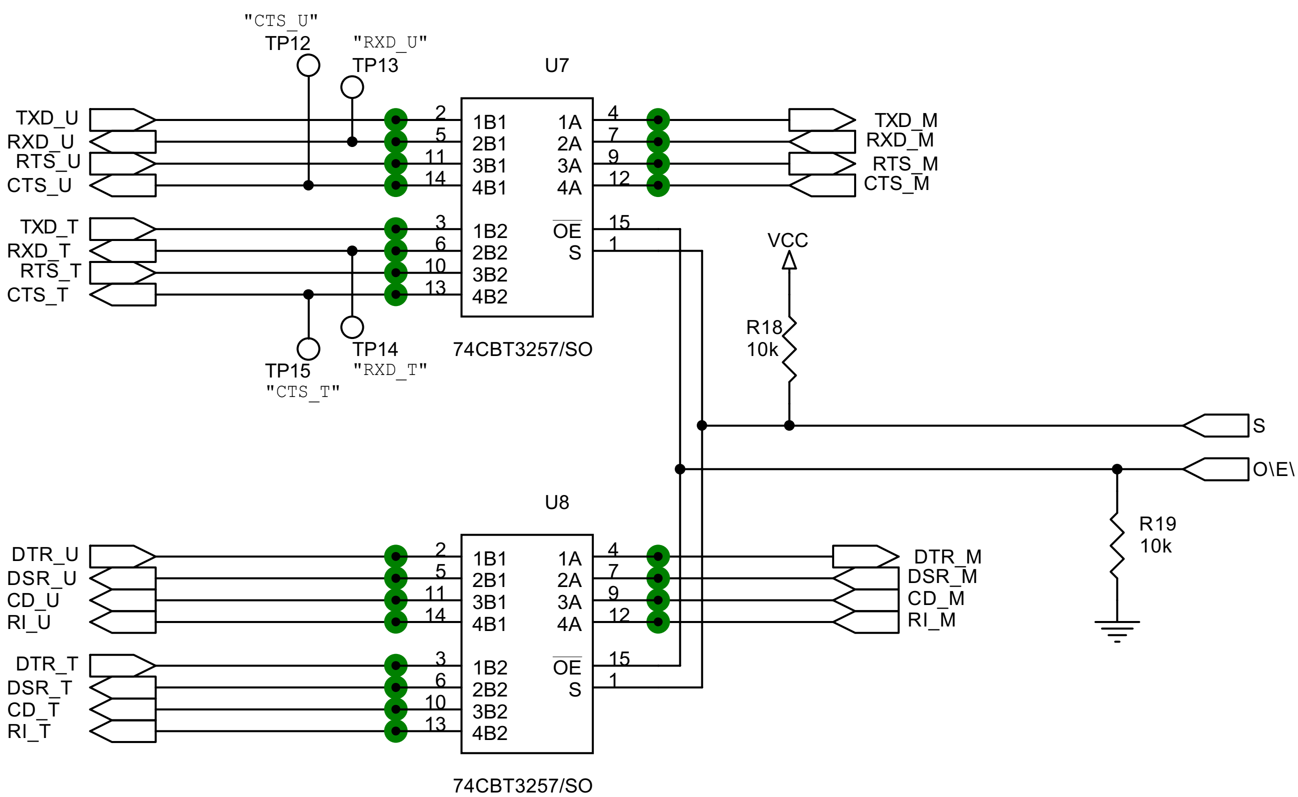


Figure 18. UART Mux Schematic

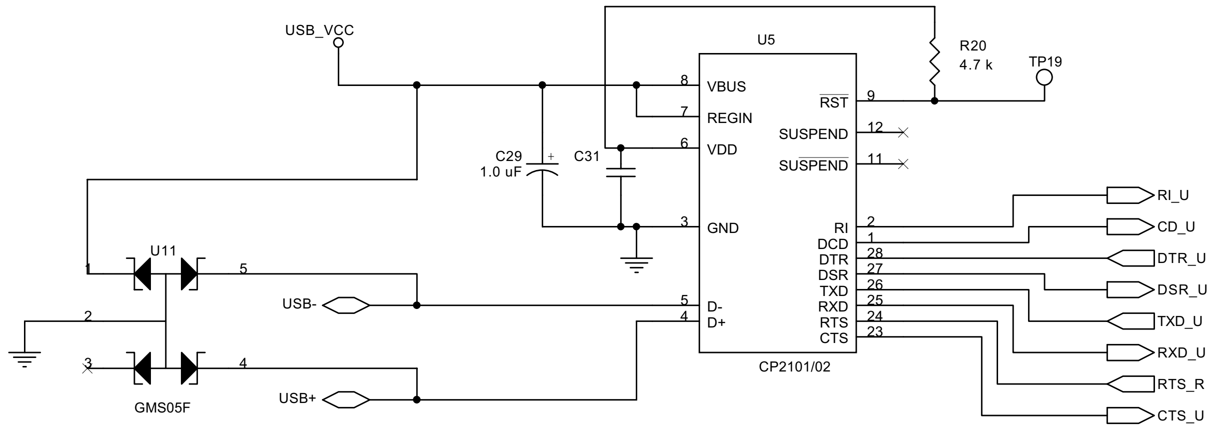


Figure 19. USB Interface Schematic

5. Bill of Materials: Si24xx Motherboard

Item	Quantity	Reference	Value	Rating	Tolerance	Foot Print	Dielectric	Manufacturer Number	Manufacturer
1	5	C1,C3,C12,C15,C29	1.0 uF	10 V	±10%	3216_EIAA	Tant	TA010TCM105-KAL	Venkel
2	4	C2,C4,C11,C13	470 pF	25V	±5%	CC0805	X7R	C0805C471J5GACTU	TTI
3	1	C5	10 nF	16 V	±10%	CC0603	X7R	C0603X7R160-103KNE	Venkel
4	1	C6	470 uF	25 V	±20%	C5X10MM-RAD	Electrolytic	UVX1E471MPA	NIC Components
5	2	C7,C9	0.1 uF	25 V	±10%	CC0805	X7R	C0805X7R250-104KNE	Venkel
6	2	C10,C8	10 uF	16V	±10%	CC1206	X7R	C1206X7R100-106KNE	Venkel
7	10	C14,C16,C17,C18,C19,C20,C22,C23,C31,C32	0.1 uF	16 V	±20%	CC0603	X7R	C0603X7R160-104MNE	Venkel
8	1	C21	820 pF	50 V	±5%	CC0805	NPO	C0805COG500-821JNE	Venkel
9	1	C24	100 uF	16 V	±10%	C2.5X6.3MM-RAD	Electrolytic	UVX1C101MEA1TD	Nichicon
10	4	D1,D2,D3,D4	DIODE	30 V	0.5 A	SOD123		MBR0530T1	Motorola
11	1	D5	BAT54C			SOT-23		BAT54C	Diodes Inc.
12	8	D6,D7,D8,D9,D10,D11,D12,D13	MMBZ15VDC			SOT-23		MMBZ15VDC	General Semiconductor
13	3	FB1,FB2,FB3	Ferrite Bead			RC0805		BLM21A601S	Murata
14	1	JP1	SOCKET 8X2			CONN2X8		SSW-108-01-T-D	Samtec
15	1	JP2	4X1 Socket			CONN4[6238]		SSW-104-01-T-S	Samtec
16	1	JP3	HEADER 8X2			CONN2X8		517-6121TN	Samtec
17	1	JP4	HEADER 5X2			CONN2X5[6238]RA		TSW-105-25-T-D-RA	Samtec
18	8	JP5,JP7,JP8,JP9,JP10,JP11,JP12,JP13	2X1 Header			CONN2[6040]		517-611TN	Berg
19	1	JP6	3x5 Header			CONN3X5			
20	1	J1	DB9-RS232_1			CONN9[6543]DBF		K22-E9S-030	Kycon
21	1	J2	RCA JACK			CONN2[12090]RCA		16PJ097	Mouser
22	1	J3	Power Connector			TB2[12065]TSA		506-5ULD02	Mouser
23	1	J4	2.1 mm Power jack			CONN3[175120]PWR		ADC-002-1	Adam Tech
24	1	J5	USB Type B			CONN-USB-B		897-30-004-90-000000	Mill-Max
25	1	LS1	Speaker			HCM12A[9052]		HCM1206A	JL World
26	1	RJ11	MTJG-2-64-2-2-1			RJ11[6238]DUAL		MTJG-2-64-2-2-1	Adam Tech
27	6	R2,R6,R7,R9,R15,R27	0	1/10 W		RC0603		CR0603-10W-000JT	Venkel
28	1	R3	47 k	1/10 W	±5%	RC0805		NRC10J473TR	NIC Components
29	1	R4	3 k	1/10 W	±5%	RC0805		NRC10J302TR	NIC Components
30	1	R5	10	1/10 W	±1%	RC0805		NRC10F10R0TR	NIC Components
31	2	R26,R8	1.3k	1/16 W	±5%	RC0603		CR0603-16W-132JT	Venkel
32	10	R10,R11,R12,R17,R18,R19,R28,R29,R30,R33	10k	1/16 W	±5%	RC0603		CR0603-16W-103JT	Venkel
33	1	R13	1.6	1/8 W	-0.05	RC1206		CR1206-8W-1R6JT	Venkel
34	1	R14	196k			RC0805		MCHRIDEZHFX1963E	Classic Comp
35	1	R16	110k			RC0805		CR21-114J-T	Classic Comp
36	1	R20	4.7 k	1/10 W	±5%	RC0805		NRC10J472TR	NIC Components
37	1	S1	SW PUSHBUTTON			SW4[6240]PB		101-0161	Mouser
38	3	TP1,TP2,TP18	Black Test Point			CONN1[6040]		151-203	Mouser
39	4	TP3,TP4,TP5,TP6	Stand off			MH-125			
40	8	TP7,TP8,TP10,TP11,TP12,TP13,TP14,TP15	Blue Test Point			CONN1[6040]		151-205	Mouser
41	2	TP16,TP17	Red Test Point			CONN1[6040]		151-207	Mouser
42	1	TP19	Blue Test Point			CONN1[6040]		151-207	Mouser
43	1	U1	7805			TO-220-LD		uA7805CKC	Texas Instruments
44	1	U2	TPS77601DR			SO8		TPS77601DR	Texas Instruments
45	1	U3	DS1818			SOT-23		DS1818-10	Dallas Semiconductor
46	1	U4	MAX3237			SOP65X780-28N		MAX3237E (Sipex SP3238E 2nd source)	Maxim
47	1	U5	CP2101/02			28-pin MLP		CP2101/02	Silicon Laboratories
48	2	U8,U7	74CBT3257/SO			SOP65X780-16N		SN74CBT3257DBR	Texas Instruments
49	1	U9	PDIP Socket			DIP8-SKT		210-93-308-41-001000	Mill-Max
50	1	U10	OP-AMP			SO8		LM386M-1	National Semi
51	1	U11	GMS05F			SOT-23-5N		GMS05F	Vishay

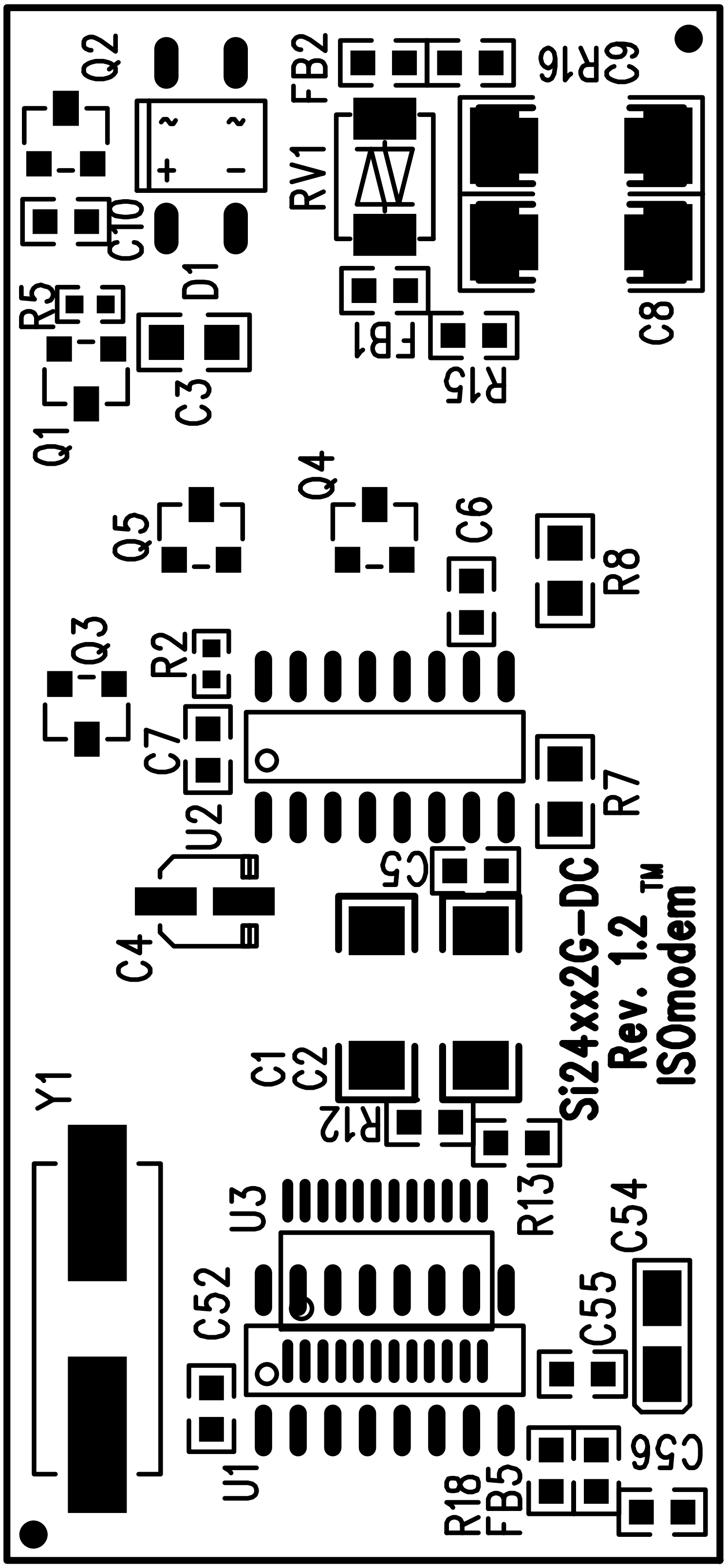


Figure 20. Daughter Card Component Side Silkscreen

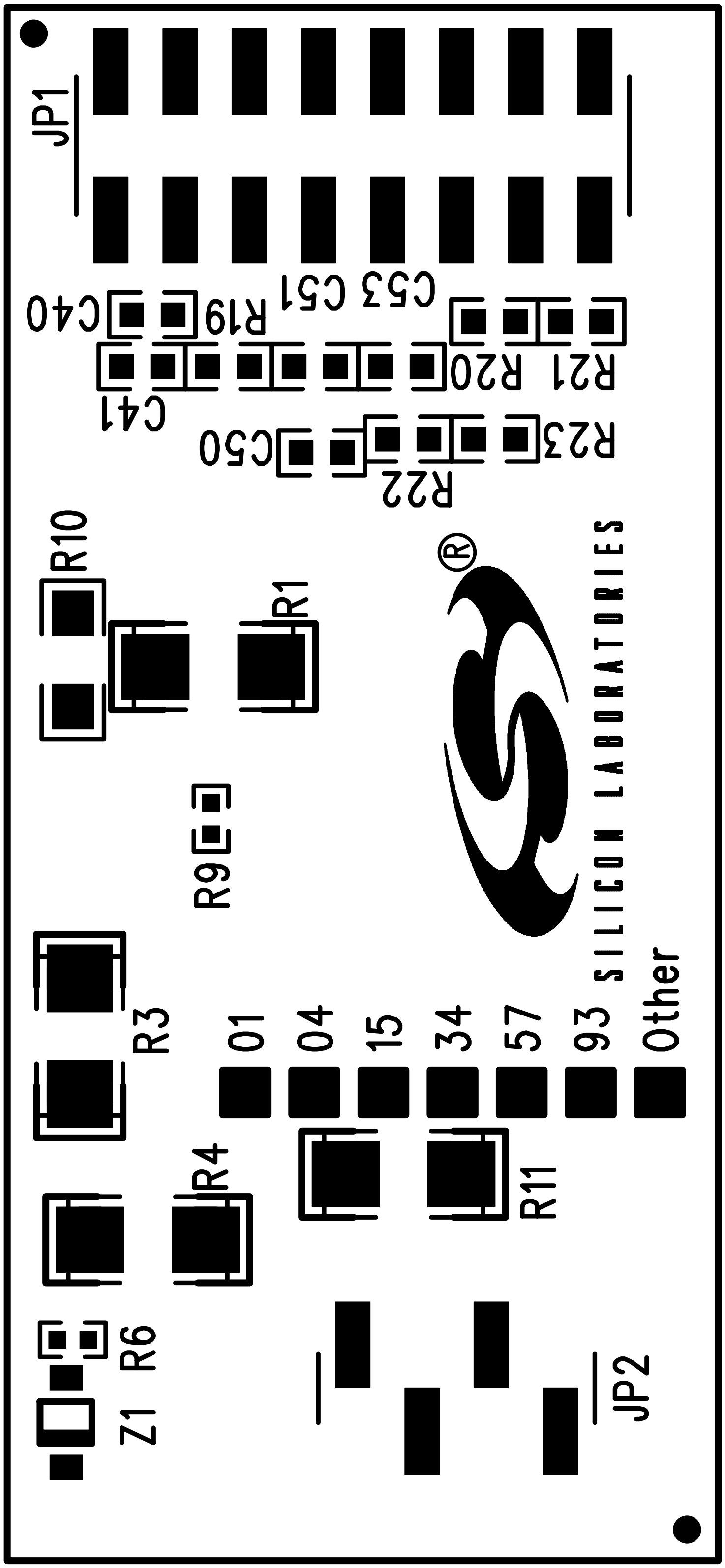


Figure 21. Daughter Card Solder Side Silkscreen

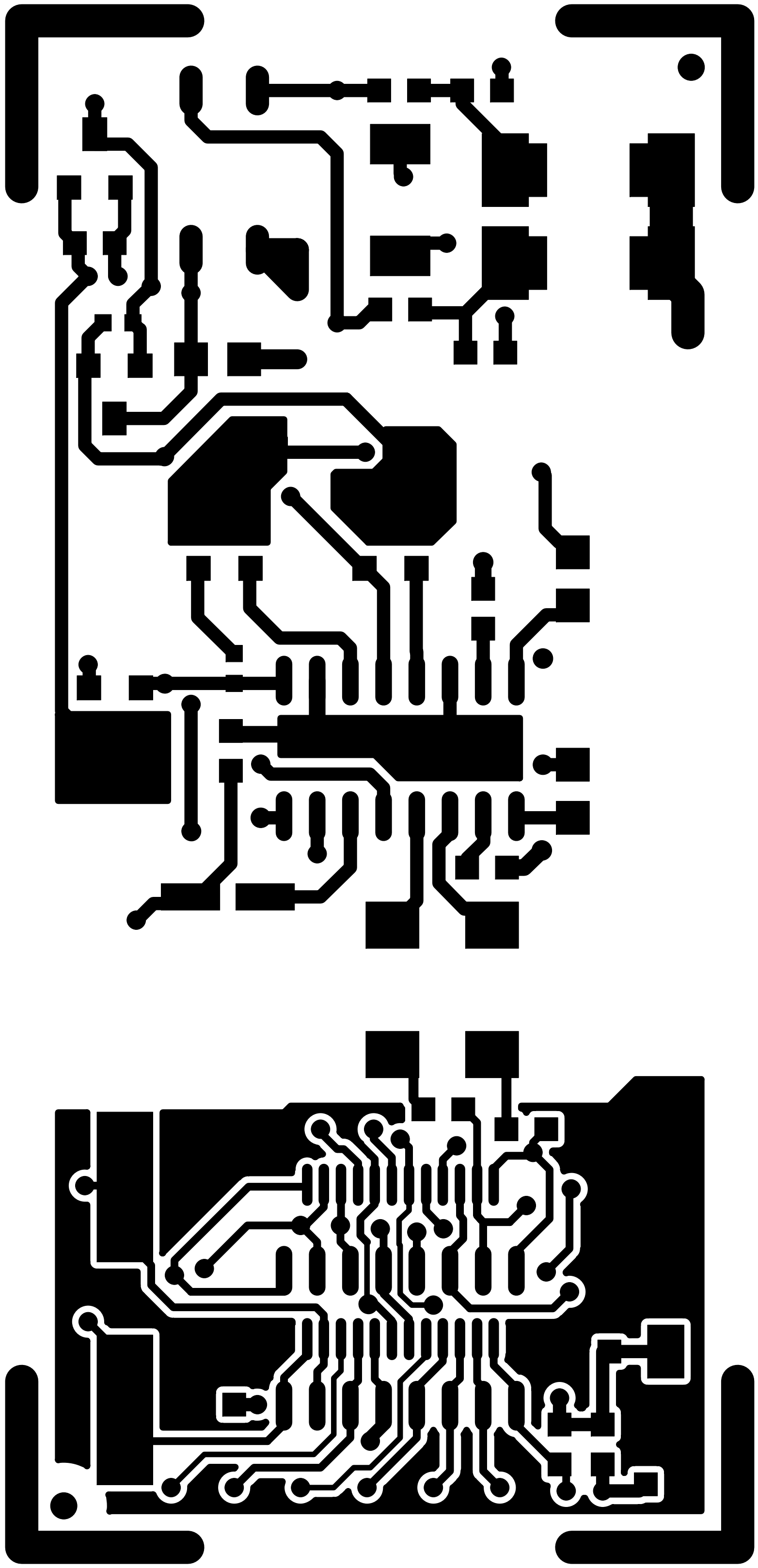


Figure 22. Daughter Card Component Side Layout

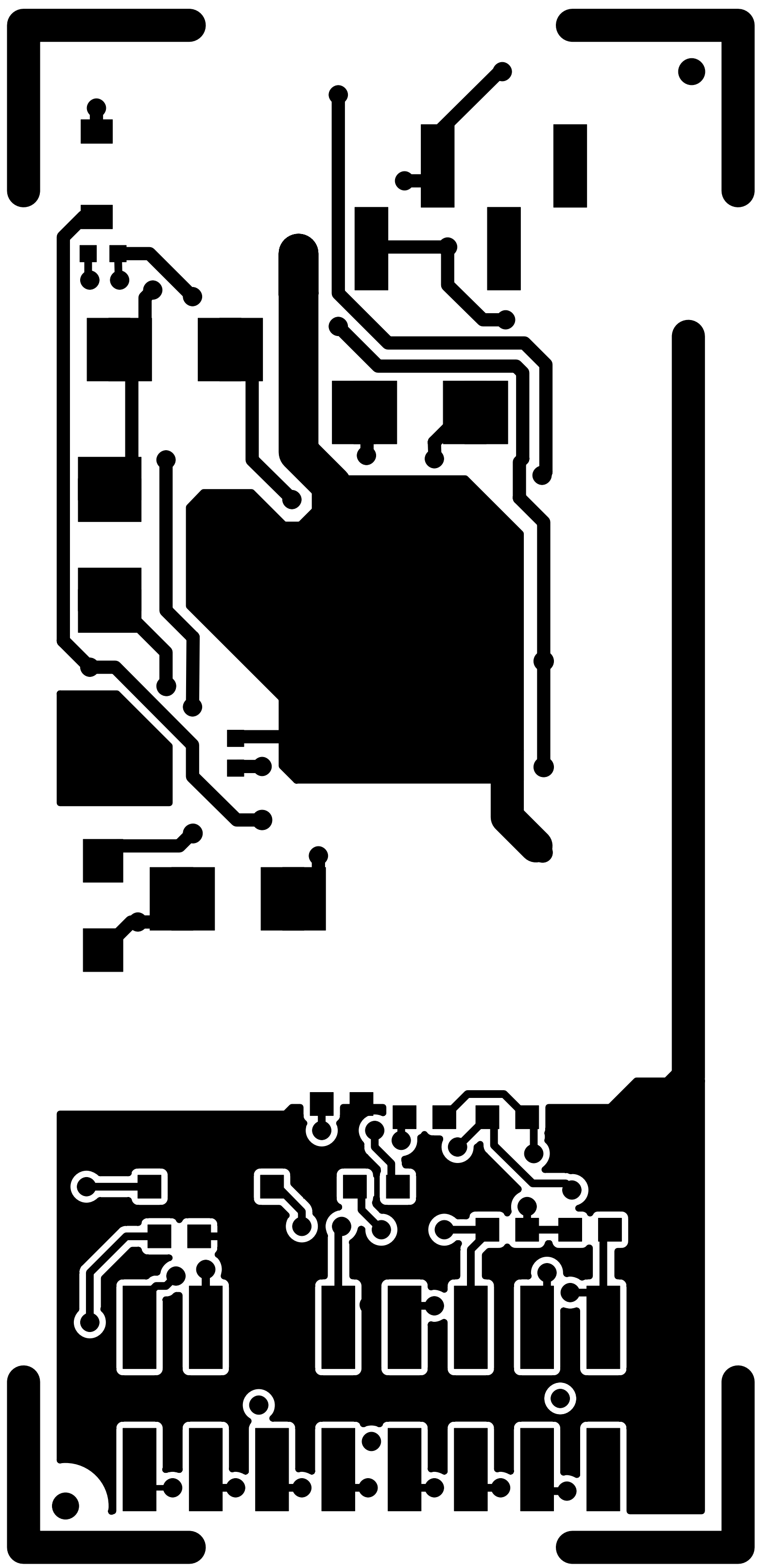


Figure 23. Daughter Card Solder Side Layout

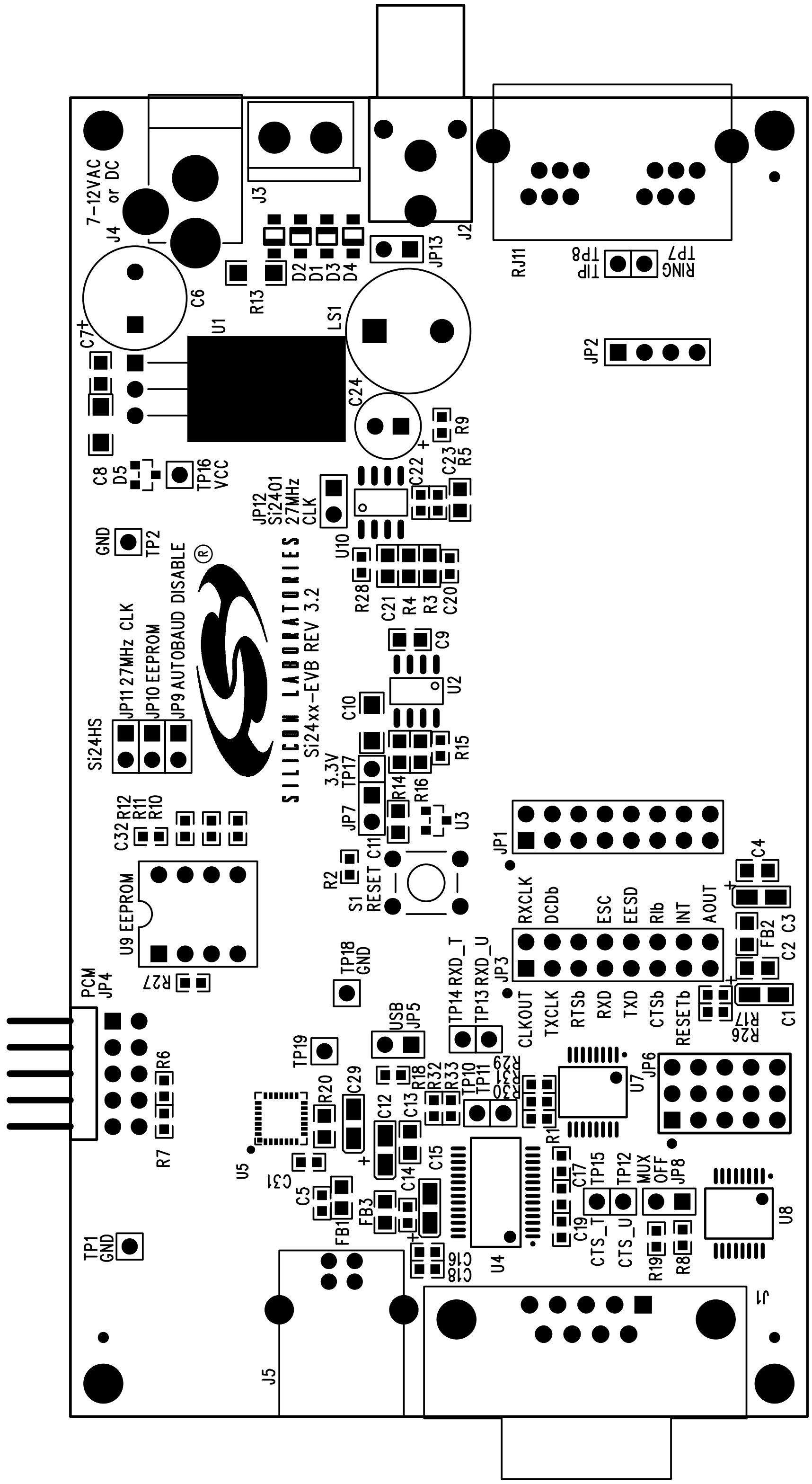
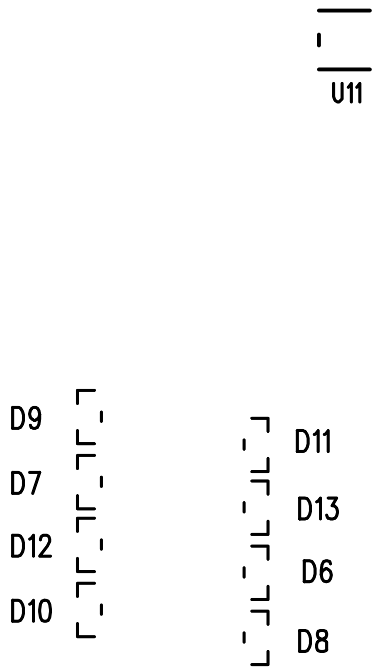


Figure 24. Motherboard Silkscreen



Si2401	Si24HS	Si2400	Function	RS-232
GPIO2 or NC	DCD or EESD	NC or GPIO2	Info	CD
NC or GPIO5	RI or TXCLK	GPIO3 or NC	Info	RI
GPIO3 or NC	ESC or X	GPIO1 or GPIO3	Ctrl	DTR
NC or GPIO1	RTS or RXCLK	CLKOUT or NC	Ctrl	RTS
NC or GPIO4	INT or AOUT	GPIO4 or AOUT	Info	DSR

JP6 recommended settings
Si2400: 2–3, 4–5, 8–9, 11–12, 13–14
Si24HS: 1–2, 4–5, 7–8, 10–11, 13–14
Si2401: 1–2, 5–6, 7–8, 11–12, 14–15
Si24HS alt: 1–2, 5–6, 7–8, 11–12, 14–15

Figure 25. Motherboard Silkscreen (Back Side)

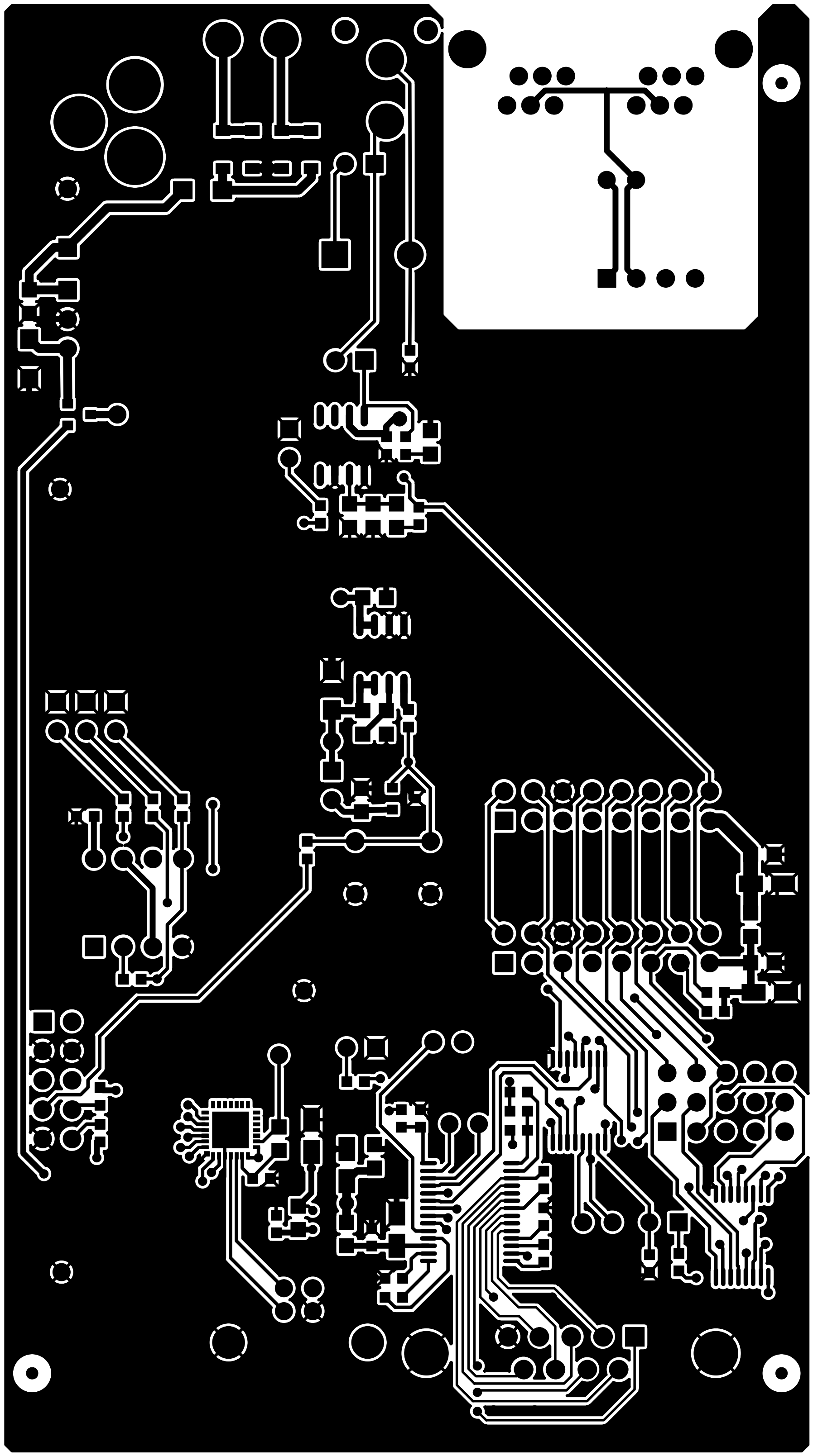


Figure 26. Motherboard Component Layout

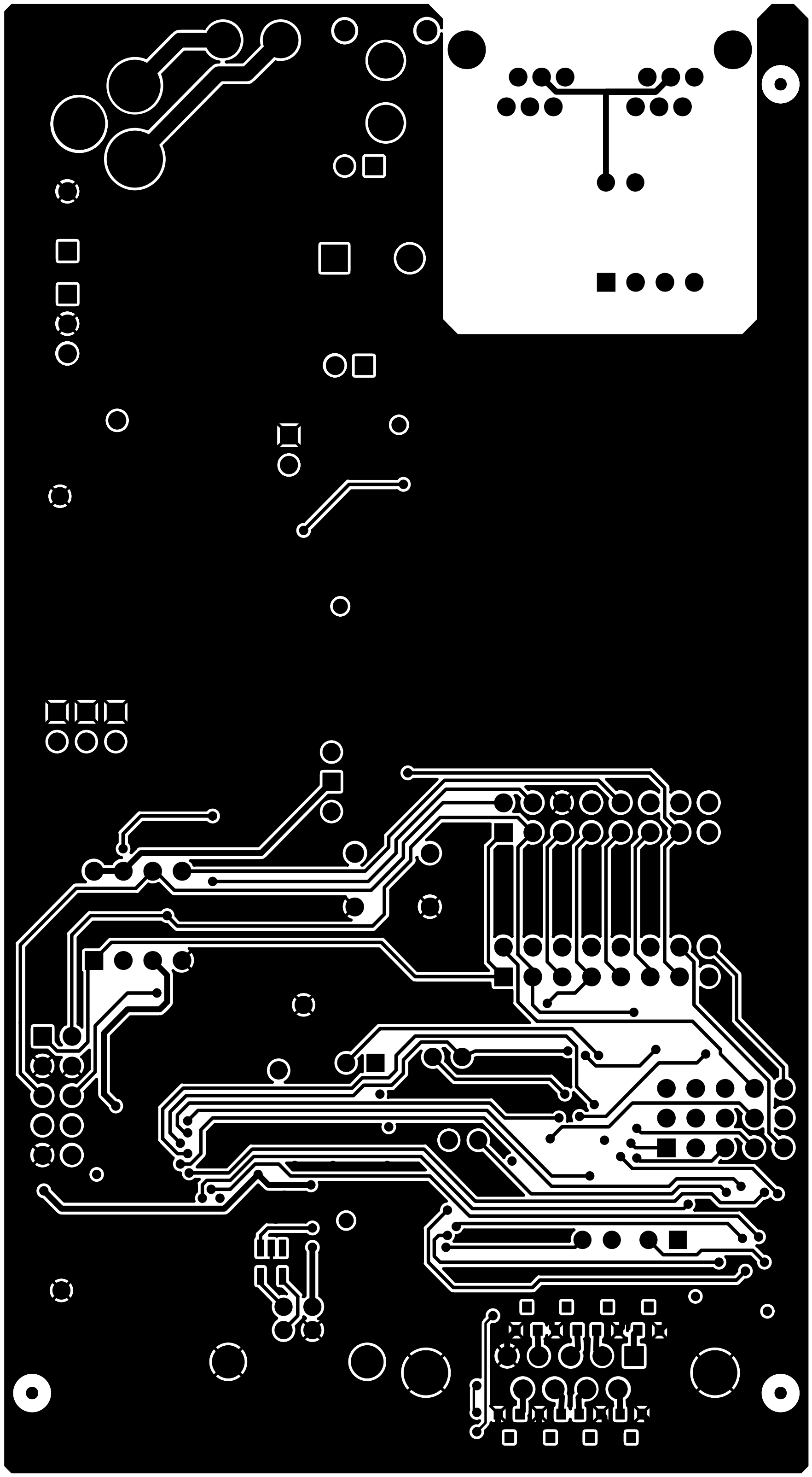


Figure 27. Motherboard Solder Side Layout

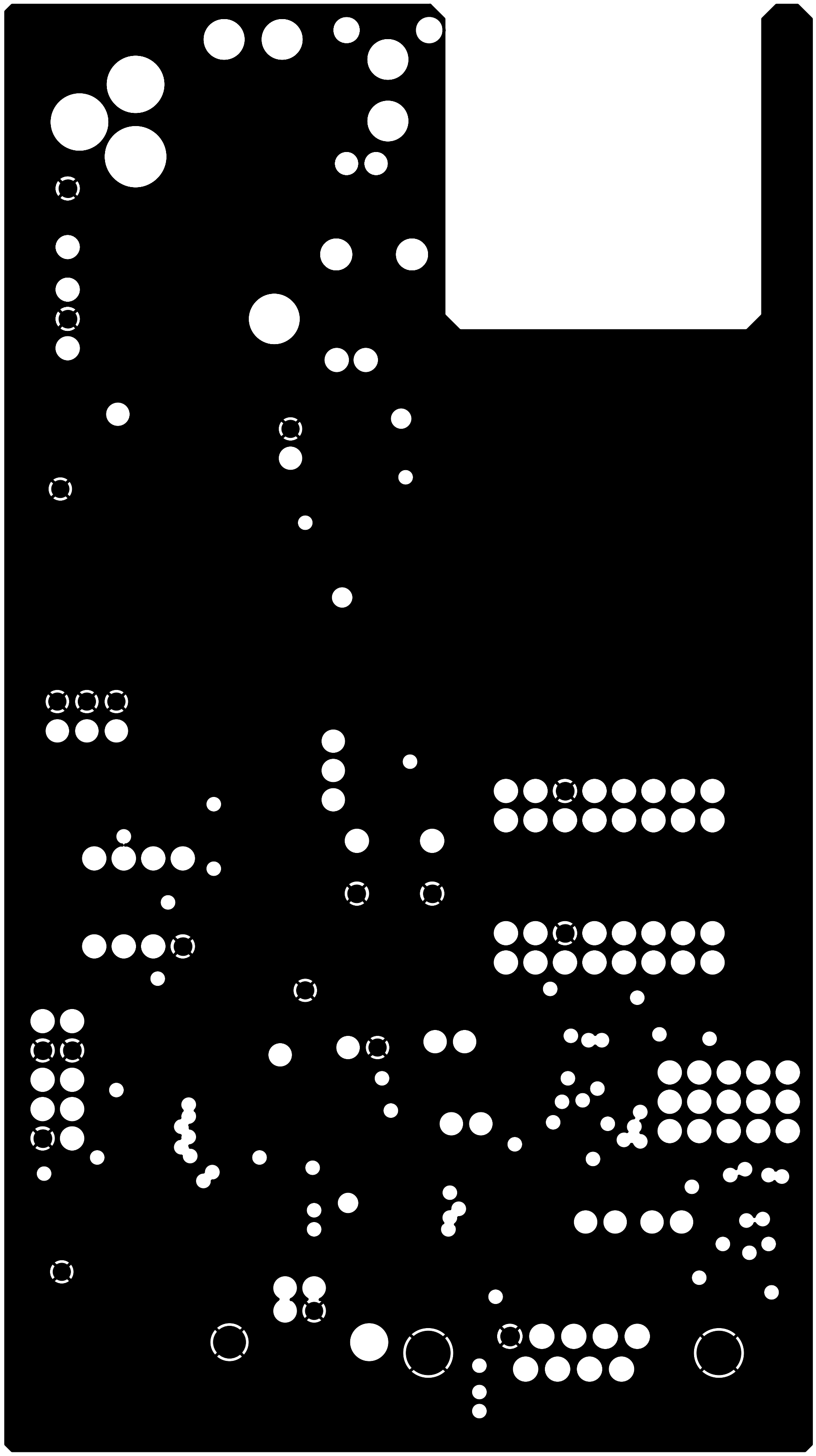


Figure 28. Motherboard Ground Plane Layout

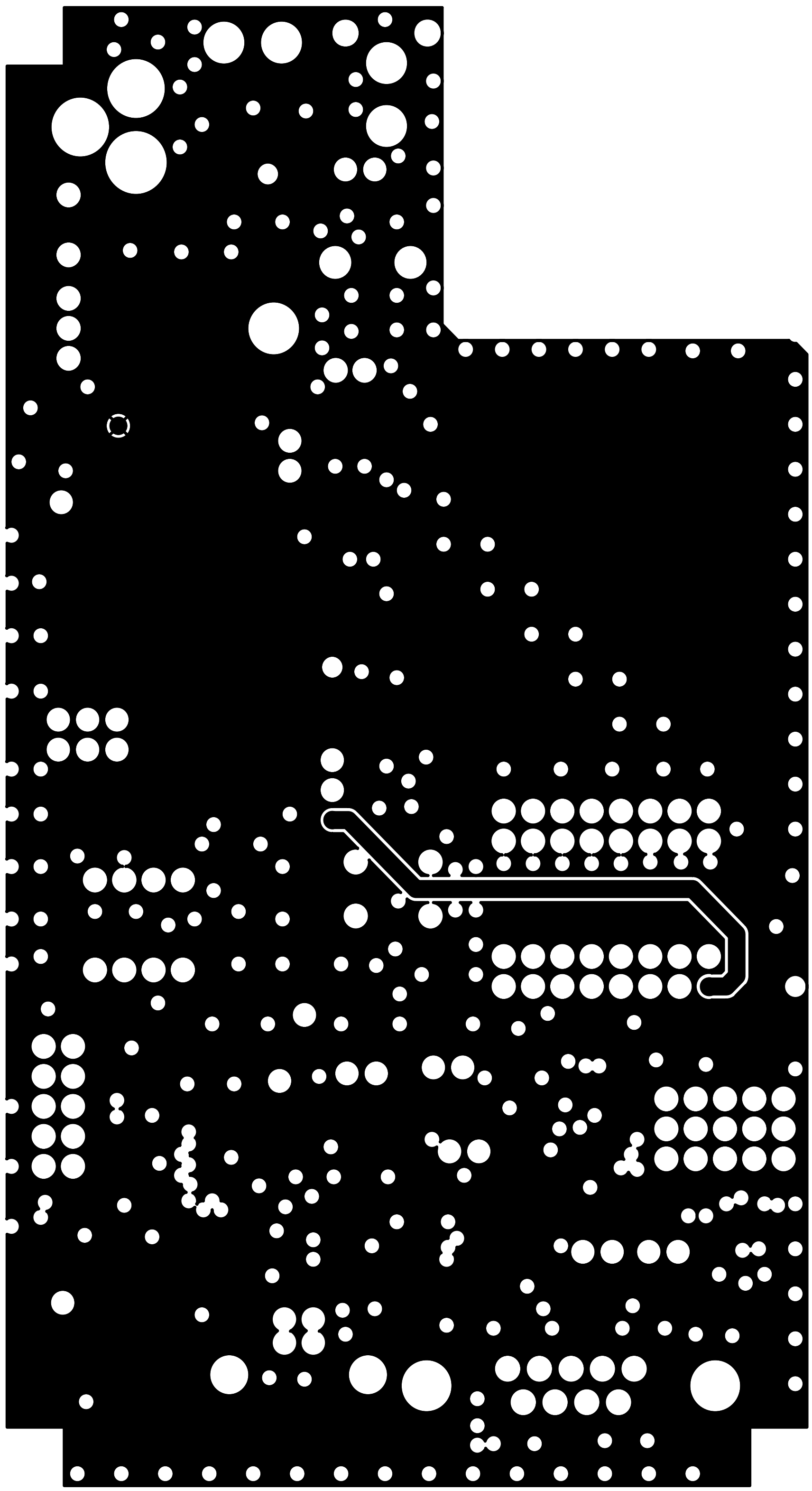


Figure 29. Motherboard Power Plane Layout

6. Complete Design Package on CD (See Sales Representative for Details)

Silicon Laboratories can provide a complete design package of the Si2493/57/34/15/04-EVB including the following:

- OrCad Schematics
- Gerber Files
- BOM
- Documentation

Please contact your local sales representative or Silicon Laboratories headquarters sales for ordering information.

Document Change List

Revision 0.2 to Revision 0.3

- Updated Figure 21, “Daughter Card Solder Side Silkscreen,” on page 25
- Updated Figure 22, “Daughter Card Component Side Layout,” on page 26
- Updated Figure 23, “Daughter Card Solder Side Layout,” on page 27
- Updated “Bill of Materials: Si24xx Daughter Card”

Revision 0.3 to Revision 0.4

- Changed from Rev.1.0 to Rev.1.1 Daughter Card

Revision 0.4 to Revision 0.5

- Changed from Rev.3.1 to Rev.3.2 Motherboard

Revision 0.5 to Revision 0.6

- Changed from Rev.1.1 to Rev.1.2 Daughter Card
- Added FS (SOIC) Package Option

CONTACT INFORMATION

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